POWER PLANT ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

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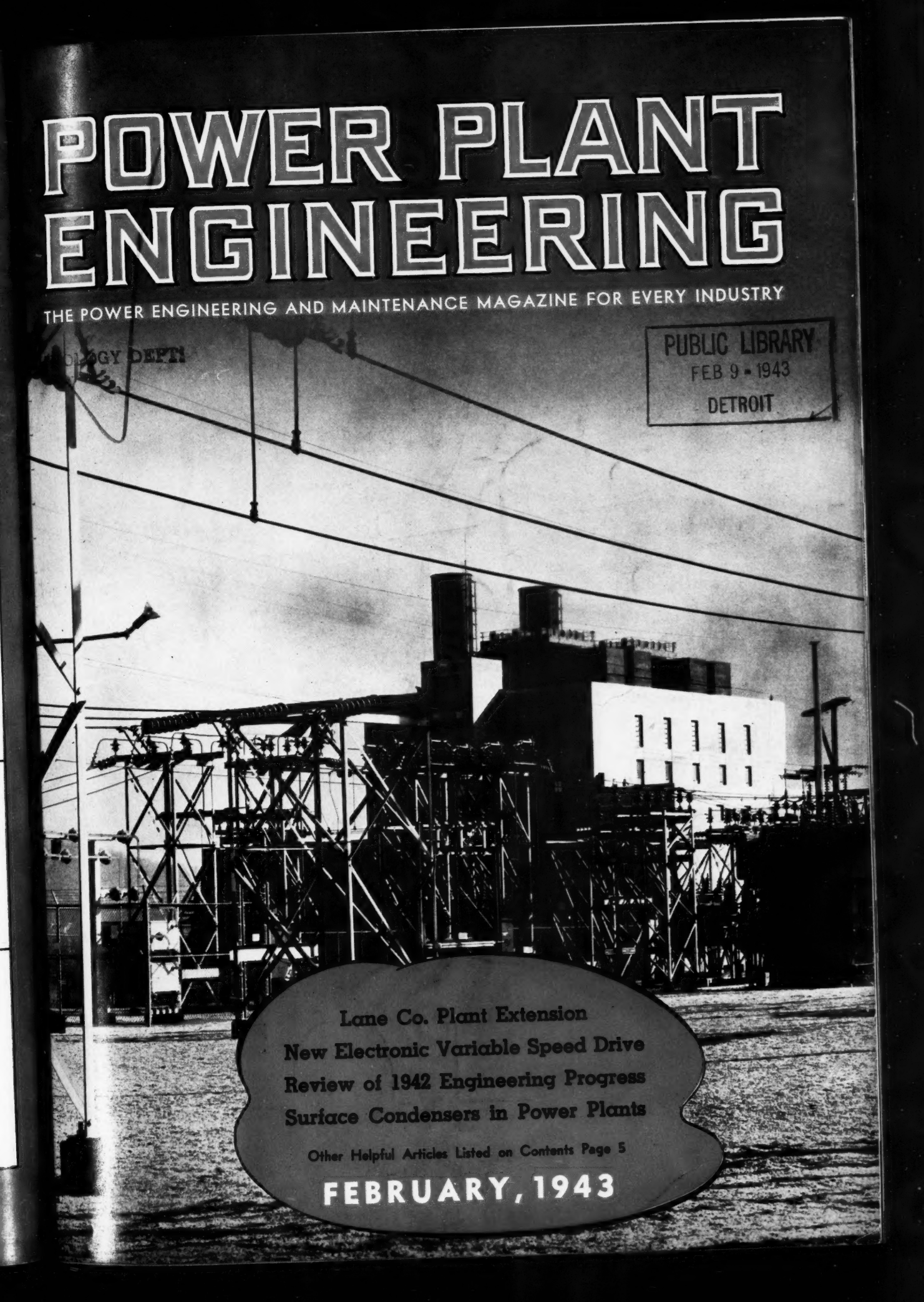
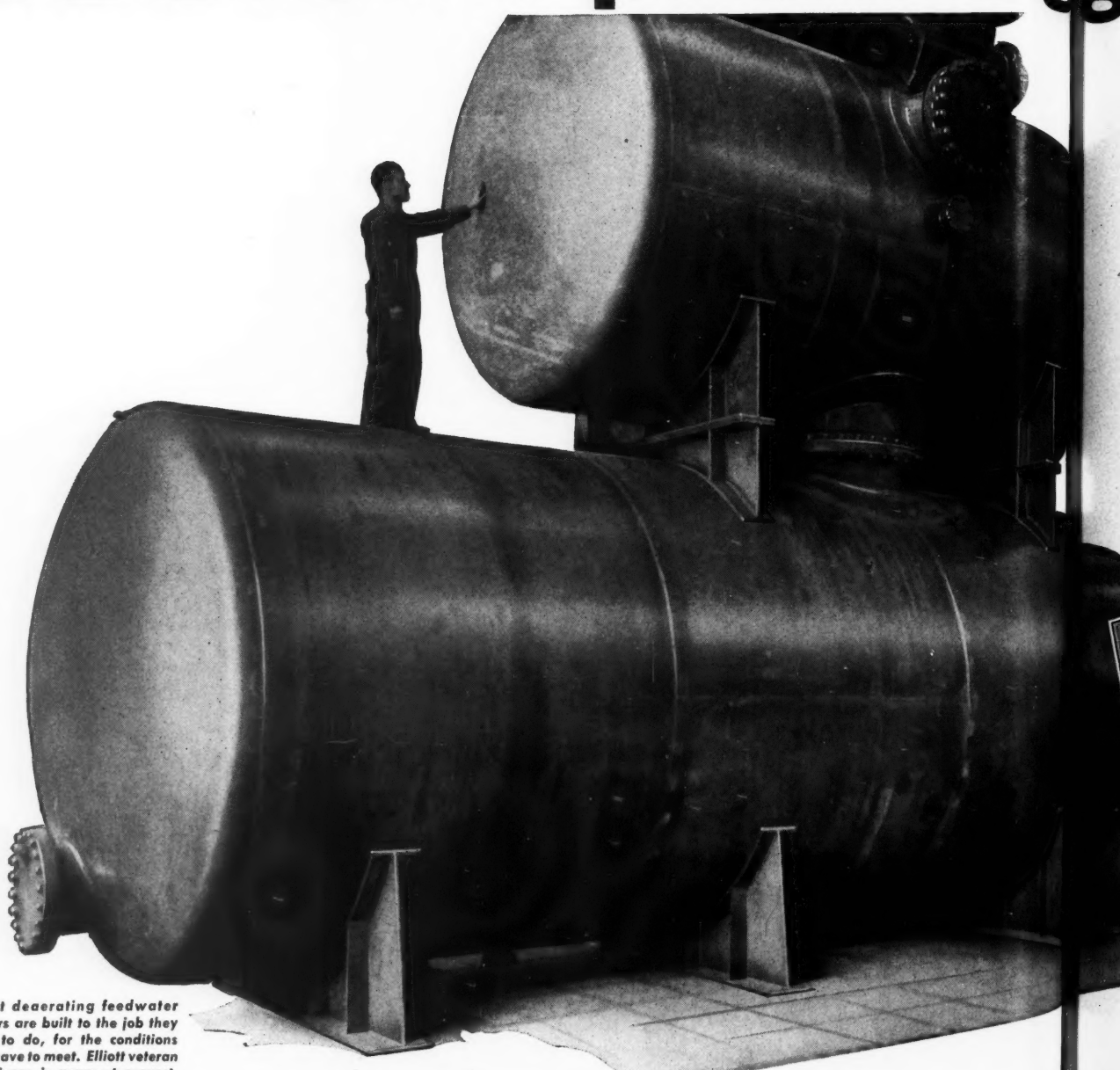


Lane Co. Plant Extension
New Electronic Variable Speed Drive
Review of 1942 Engineering Progress
Surface Condensers in Power Plants

Other Helpful Articles Listed on Contents Page 5

FEBRUARY, 1943

ELLIOTT pioneering



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It is a silent but deadly war against an insidious enemy — an enemy that rates as an ally of the Axis, like any other form of sabotage. This War with Corrosion is being won daily, hourly, in the power plants of America, by deaerating equipment designed on the basis of Elliott Company's past research and engineering developments in what was then an untrodden field of exploration.

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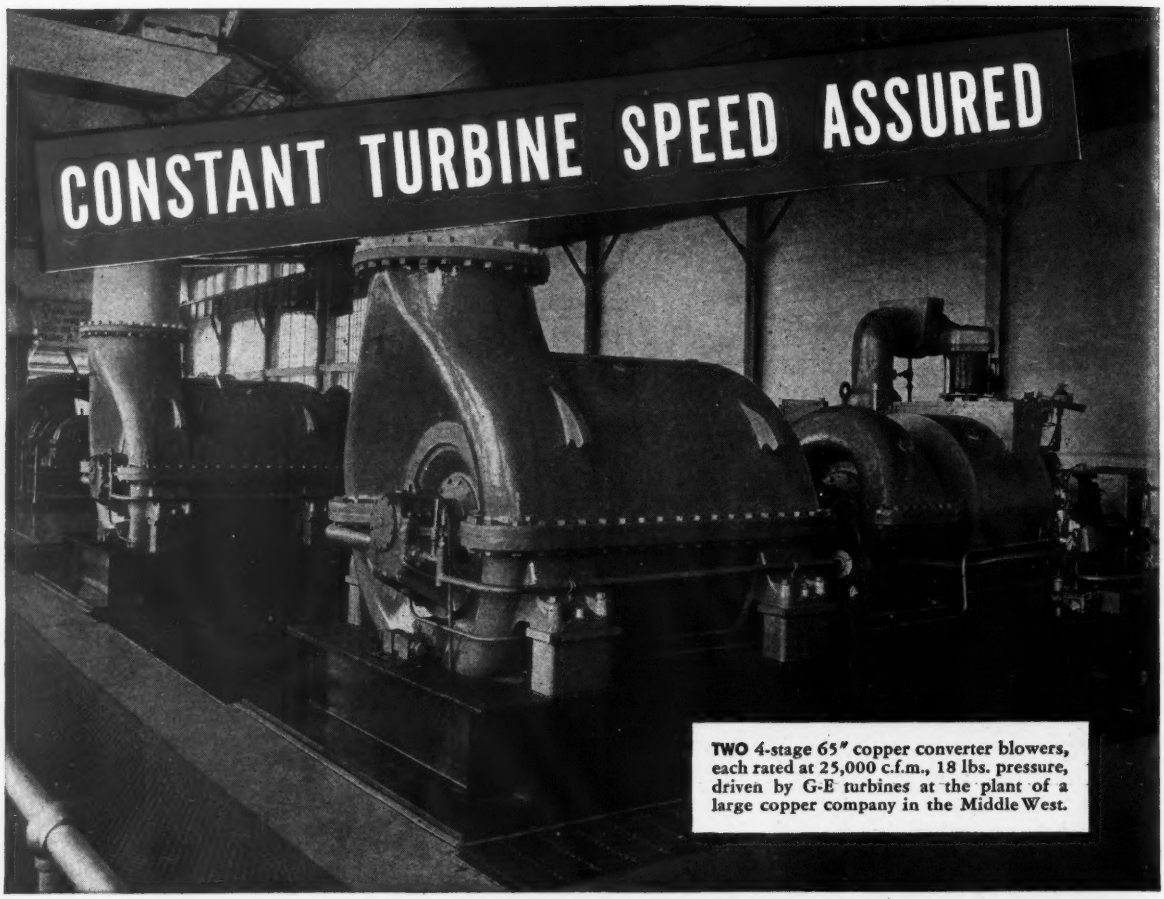

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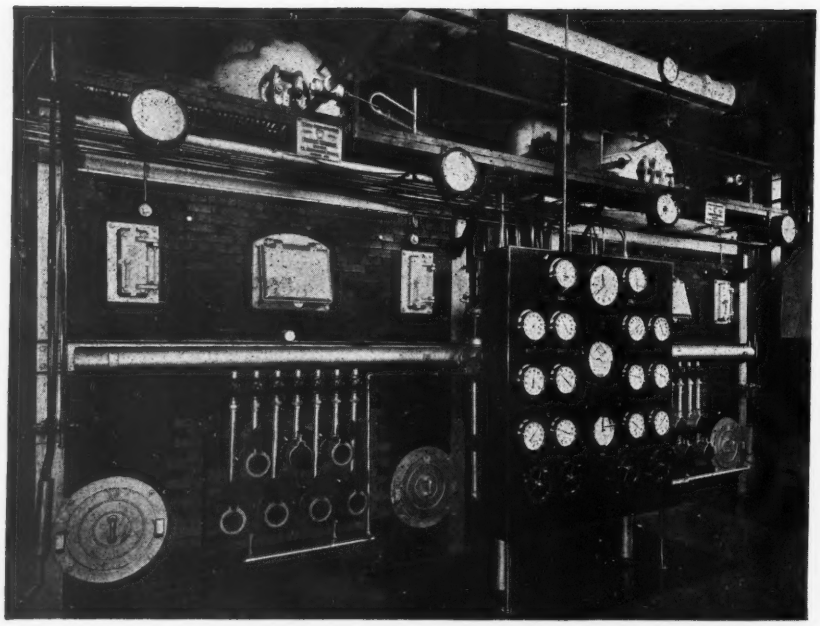

Boiler fronts of the two original gas fired "S-A" boilers at Calgary. The instrument panel between the boilers reports operating conditions throughout the hospital system including laundry, sterilizers and fire system, as well as recording meters on boiler performance.

3rd "S. A." Unit in 14 Months!

Two "S-A" boilers of 10,000 lb. per hour capacity were installed at the General Hospital in Calgary, Alberta, in 1941. They were designed for a pressure of 150 lb. per sq. in. and have frequently operated at 190% of rating. In regular service they show nearly 5% increase in efficiency over the estimated figure.

Performance has been so eminently satisfactory and the Foster Wheeler "S-A" design fits wartime requirements of "maximum steam from minimum materials" so precisely, that when increased steam demands made an extension necessary, a third "S-A" boiler—a duplicate of the two already in service—was ordered for the Calgary General Hospital.

The Army-Navy Production "E" has been awarded to Foster Wheeler in recognition of quality equipment, in quantity, on time.

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FRONT LINES

Designing and building assembly and welding fixtures were the principal problems in converting the Lincoln automobile plant to manufacture jeeps, L. B. Rivard told the S.A.E. meeting. Fortunately, the Lincoln men found another manufacturer of bodies of an earlier vintage already in production but they had no drawings or blueprints of their equipment. Accordingly, every fixture was photographed individually, then measured, and the dimensions applied directly to the photographs. With this information, the Lincoln maintenance men built their platforms and constructions by welding channel, angle and flat plate steel, obtained by cutting up stock racks already on the floor. Thus they saved the time necessary for designing and drawing these tools.

The OPA whip is cracking sharp over the heads of fuel oil users as this is written. Commercial buildings in 30 states have been given the choice of converting or losing their rations by the end of January unless they can present written proof that arrangements have been made for conversion by a definite date or that conversion is impossible. OPA insists that necessary conversion equipment is available, that they have given property owners months to do their wartime duty in this matter and that the policy now is definitely "no conversion—no oil."

Stimulating news that industry may run with the ball of postwar planning comes in the announcement of industry's Committee for Economic Development, headed by Paul Gray Hoffman, president of Studebaker Corp. Of highest importance is the fact that the chairman of its important research committee is Ralph E. Flanders, president of Jones and Lamson Machine Co. As far back as May, 1940, Ralph Flanders, in his masterly paper Progress Report of An Amateur Economist before the A.S.M.E. at Worcester, presented a comprehensive proposal for organizing our economic life, which he called A Design for Living in America. This was no mere vaporing and bumbling. It was a hard-boiled, realistic attempt, illustrated by an engineering diagram of the design, to solve this nation's No. 1 problem, unemployment. Look it up some time in the July, 1940, issue of Mechanical Engineering. It talks about **your** individual problems in war and peace.

Everybody, of course, wants to do the post-war planning. Now Congressman Jerry Vorhis says Congress ought to do it. He proposes a congressional committee, to be advised by a commission composed of: 3 representatives each from industry, labor, agriculture, religion, co-operative groups, ex-service men's groups (1 to be a combat veteran of World War II); 2 representatives each from educators and consumers' groups; 1 economist—AND—1 engineer. Unwashed, sanguinary fighters in Africa and Guadalcanal, engineers wading in red tape and cutting fluid on the production lines—how they will cheer this proof of their relative importance in running the new world they fight to create! Why, an engineer will be almost as important as an economist!

High frequency induction heat used in a brazing operation on war goods at a G.E. plant in the East has reduced the time for the operation from 4 min. to 40 sec., has eliminated the need for highly skilled workers to perform the work. Women operators are now used, according to J. P. Jordan of the G.E. Radio, Television and Electronics Dept., a uniform joint is achieved, inspection of this operation is eliminated. The part to be heated is placed in a water-cooled, copper tubing coil and current is passed through the coil at frequencies in the order of 500,000 cycles per second. This generates the pulsating magnetic field that heats the part.

Production of standards in 1942, like all other production, hit an all-time high, according to R. E. Zimmerman, President of the American Standards Association. This body has completed 73 new standards and revised 49 existing standards during the year, and in addition completed 10 American War Standards requested specifically by WPB, OPA or other governmental agency. Vital in the coordination of the national effort, both in repair work and in dovetailing of supplies both here and abroad, are many of the jobs the A.S.A. is doing for WPB and OPA, such as standards for men's safety shoes, effective lighting of industrial properties, materials and parts for military and civilian radios. Standards immediately available for war, prepared in peace by A.S.A., included more than 80 mechanical standards for parts, tools, bolts, screws, bearings, etc., together with 70 safety standards for protection of workers, electrical standards for motors, wires and cables, switchgear, etc. A.S.A. is cooperating on standardization with other American countries, feels that much of its work in the mechanical and consumer fields will be broadened for peacetime purposes, will help lay firm foundations for the post-war period.

Construction of natural gas pipelines would help solve the wartime fuel problem for industrial centers such as the Chicago metropolitan area, Detroit, Minneapolis, St. Paul, Omaha, St. Louis and Kansas City. a senate investigating committee was told. Director E. Holley Poe, of the War Petroleum Administration's natural gas and natural gasoline division, said a major program of pipeline construction would be necessary in the near future if adequate supplies are to be maintained. The known natural gas reserves of the nation today are in excess of 85,000,000,000,000 cu. ft., he says, and in some areas the amount of gas to be utilized is limited only by the capacity of pipelines now in existence.

Diversion of a mighty flow of water from the James Bay watershed to that of the St. Lawrence, a project that the Hydroelectric Power Commission of Ontario expects to complete in about 6 mo., is another one of those attempts to change the face of nature that the people of the American continent seem to take in their stride. The only other nation that has attempted things on this scale is Soviet Russia. Some years ago, you will remem-

ber, the Russians literally moved a mountain, changing the course of a great river in Northern Siberia to make a system of canals flow in the desired direction. In the Canadian project, a series of dams will divert an average of 5000 cu. ft. per sec. of water into the St. Lawrence watershed, raising the average level of the Great Lakes about 2½ in. and making possible the development of a total of 360,000 hp. in various hydroelectric projects.

If you have a square peg you want to use, you don't have to try to fit it into a round hole any more, because now you can get a drilling device that will drill a square hole for you by rotary action. This was done, according to the Ohmite News, by designing the drill, guide plates and rotary action in such a way that the center of the bit followed a series of cycloidal arcs.

Effective sealing of large hydrogen-cooled generators is promised, according to Brown Boveri Review, via Combustion, by the development of a gland that, compared to American designs, allows perfect shaft sealing. This design is based on one developed some years ago for Frigibloc units and for blowers handling gas and vapor. The oil losses registered with this gland were less than one per cent of those of American sealing-gland designs and the makers hope even to reduce this figure.

And speaking of high frequency current, it now makes tin go three times as far as it did before. Everybody must have heard by this time of the unusual Westinghouse process for electroplating steel sheet with tin and fusing the tin into a smooth protective coating by the use of high frequency heating. A timely application of scientific research to a vital wartime problem, this process is being applied to coating sheet steel at speeds up to 1000 ft. per minute. A number of problems in control of this process are rapidly being ironed out and much may be expected of it.

One of the proudest statistics that the publishing business is of, these days, concerns the amount of stapling wire saved by omitting one or more staples in magazine bindings. Not to be outdone, Power Plant Engineering announces that, by omitting one staple from its binding, it has saved 0.478 mi. of No. 20 by 24 stapling wire, weighing 0.0041 t. per issue. Multiply that by 12 mo., divide by the total number of readers, multiply by the square root of the amount of blue (Angstrom units) in the editor's necktie and you have a statistic that is a statistic.

Mixing of oil and coal to produce a liquid fuel suitable for use in many industrial oil burning furnaces has been suggested by the Bureau of Mines as a possible means of alleviating the fuel oil shortage in the Eastern seaboard states. (See Power Plant Engineering, December, 1942, p. 162.) It is now reported that at least one organization has begun experiments along this line, in one case using a mixture of 55 per cent fuel oil and 45 per cent pulverized coal. There is nothing new, of course, in attempting to burn a coal and oil mixture, for experiments in this field have been going on for the past 30 yr. However, in view of the present fuel oil pandemonium, the present coal-oil mixture experiment may lead to some relief for a few industrial plants, a large number of commercial plants, but, alas! none at all for the domestic user.

If you can't buy an alarm clock or get your watch reconditioned at the factory, it's because the entire instrument industry is literally swamped with war orders. An average medium bomber requires 150 instruments; a tank, where simplicity is paramount, nearly two dozen. Portable radios need several instruments, ships need numberless types. Many new instruments can't be described now. One makes possible blind landing of planes, another enables the pilot to measure his own blood's oxygen content so he can adjust his oxygen supply. Cargo and naval vessels use a salinity indicator to warn of salt in the fresh water system. As Lord Kelvin said, when you can measure something, you really know something about it.

Rubber Substitute Found by Error Put in Production, says a Chicago Sun headline. This is Neoflex—a rubber substitute developed from the blood and bones of livestock. Its inventor, Ralph R. Stark, says that about 14 yr. ago, in a laboratory where he was trying to develop a plasticizer, a workman put some materials in the wrong container and the result was a rubbery mess, which was thrown away. About a year ago he remembered the experiment and again tried to make a rubber substitute of the same materials. Now he says he has 116 different formulations. A Neoflex product is now being made by the Forman Ford Co., of Minneapolis, for sandblast stencils. The product is also expected to have applications in tire manufacture and as a coating for the inside of pasteboard containers to make them waterproof and impervious to alcohol, gasoline, oil and other petroleum products.

The above inevitably leads us to say: Don't miss an article entitled What You Don't Know Won't Hurt You, by Richard Wright, in the December, 1942, issue of Harper's Magazine. It has the perfectly dead-pan subtitle A Belated Report on the Progress of Medical Research, but don't let that fool you. It is a hilarious account of a half-hour in the animal room of a well-known hospital, where two of the attendants got into a fight during their lunch hour. They knocked over cages and dumped diabetic dogs, Wassermann guinea pigs, tubercular rats onto the floor in a seething mass. Horrified, the men restored the animals to the cages. But how could they tell which animals belonged in which cages? They couldn't. Yet nobody else ever knew anything had happened. "What," the author asks, "went on in the laboratory after that secret disaster? Was some tested principle given a new and strange refinement because of fresh remarkable evidence? Did some brooding researcher get a wild, brief glimpse of a new scientific truth?" They never heard.

Conserve chemicals!

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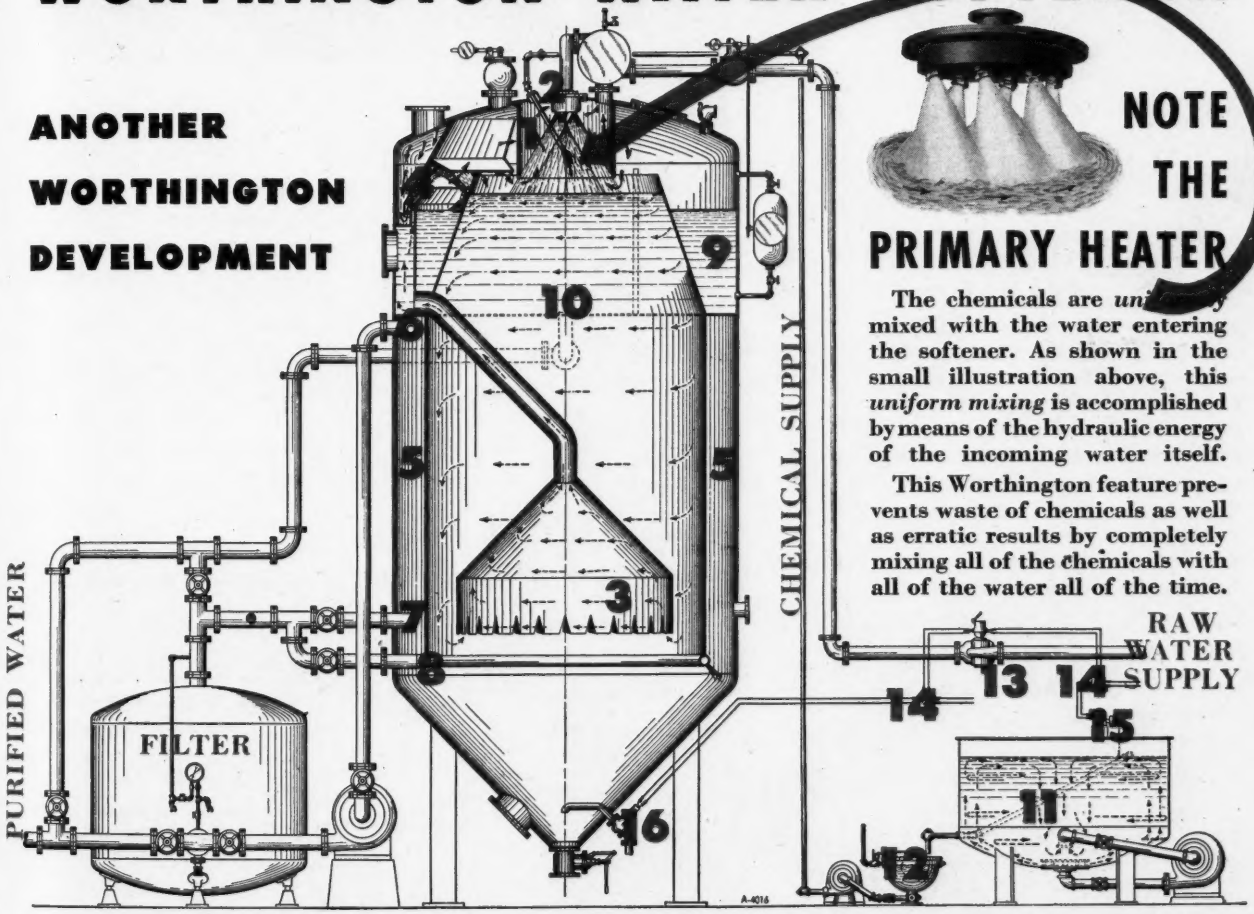
WORTHINGTON WATER SOFTENER

ANOTHER WORTHINGTON DEVELOPMENT

NOTE THE PRIMARY HEATER

The chemicals are *uniformly* mixed with the water entering the softener. As shown in the small illustration above, this *uniform mixing* is accomplished by means of the hydraulic energy of the incoming water itself.

This Worthington feature prevents waste of chemicals as well as erratic results by completely mixing all of the chemicals with all of the water all of the time.



. . . *and check these other features*

1. Primary Heater. (See above).
2. Chemical Applicator. Removable. Sprays chemical through steam. Facilitates mixing and reaction.
3. Up-take Cone. Baffled serrations assure even draught. Increases softener capacity.
4. Deaerating Heater. Simple. Effective. Self-adjusting. No moving parts.
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6. Supply to Filter Wash Pump Suction.
7. Discharge of Dirt Laden Wash Water. Reclaimed by settling clear within 1½ hours.
8. Cleansing Ring. Provides uniform distribution of jets for washing softener precipitate and wash water sediment to central area of conical bottom.
9. Storage for Treated and Deaerated Water.
10. Treated and Deaerated Water Outlet to filters or direct to boiler feed pumps.
11. Chemical Agitator. Maintains chemical mixture of uniform strength. No submerged bearings or paddles. No objectionable surface wave action to interfere with decantation.
12. Chemical Dilution and Pump Suction Tank.
13. Proportioning Meter. Accurate. Low loss. Equipped with totalizing register.
14. Relays. Adjustable time interval.
15. Decanting Mechanism. Sturdy. Reliable. Accurate.
16. Sludge Remover. Removes sludge in proportion to its rate of formation.

For full details Bulletin W-212-B2 is available at district offices (in all principal cities) or at headquarters.

S2-2

WORTHINGTON

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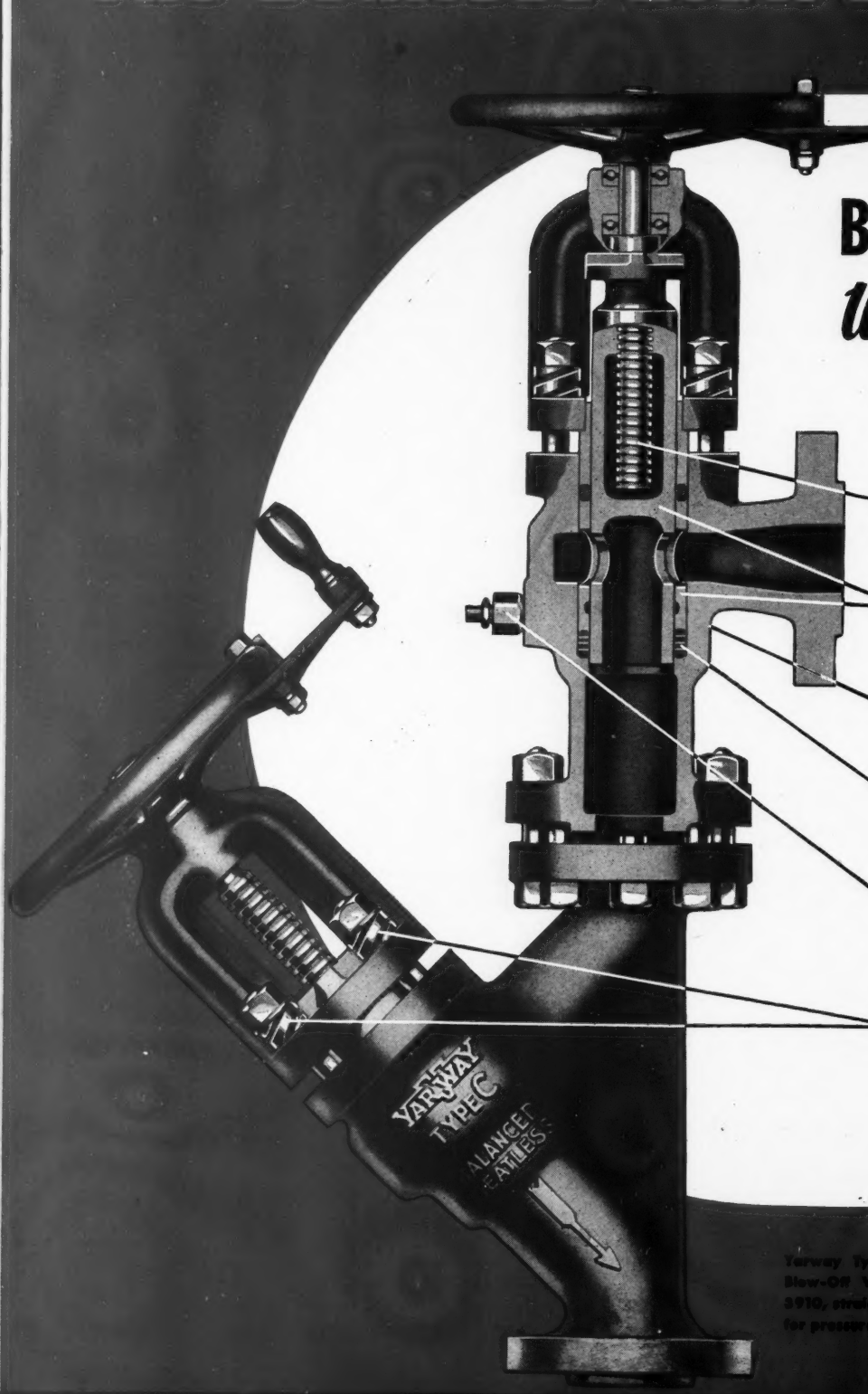
The Seatless Blow-Off Valve

BECAUSE ★ ★ ★

Wear and Clog with



Heat-treated steel stem.

Nitralloy Plunger and lower Follower Gland. Brinell hardness 1100 (upper Follower Gland, chromium plated steel).

Cast Steel Body and Yoke.

Laminated packing ring with stainless steel reinforcing inserts.

Alemite lubrication of Plunger (also for ball thrust bearings in yoke).

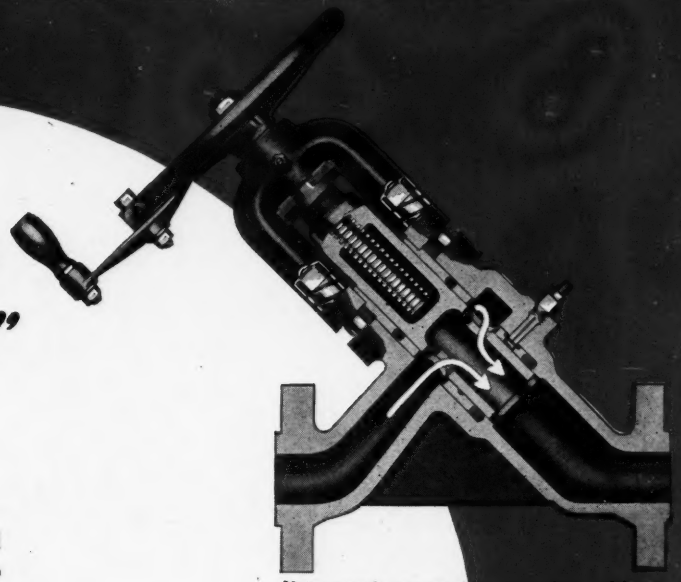
Yoke Springs maintain required pressure on packing at all times.

Yarway Type C Seatless Tandem Blow-Off Valve (angle valve Fig. 3910, straightway valve Fig. 3912) for pressures up to 600 lbs.

YARWAY

"Standard" in Over 12,000 Plants

"No Seat to *Score, Mud, Scale and Dirt*"

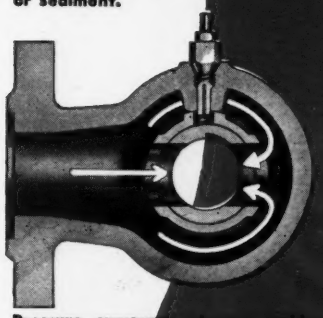


Note ample space for free flow with no projections or pockets to accumulate scale or sediment.

More than a quarter century ago, Yarway introduced their Seatless Blow-Off Valve and said—"No seat to score, wear and clog with mud, scale and dirt." Power plant operators, harassed by continuous trouble and expense with conventional valves—welcomed the Yarway as the answer to their troubles . . . purchased them, watched them, standardized upon them. And the Yarway Seatless design, in a relatively short time, became the most widely preferred blow-off valve.

Today, after a quarter century of service, it still holds that distinction. Sound fundamental design...coupled with continuous mechanical and metallurgical research anticipating ever-new service requirements . . . makes the highly improved Yarway Seatless Valve of today just as good insurance against blow-down trouble and expense in today's plants as it was in the plants of twenty-five years ago.

There is a Yarway Valve for every pressure and purpose. Write for Catalog B-422 for pressures up to 400 lbs. Catalog B-431 for higher pressures.



Pressure surrounds plunger making a fully balanced valve, easy to operate regardless of pressure.

Nitralloy plunger and lower follower gland, and laminated packing with stainless steel inserts, add years to valve life.

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia

BLOW-OFF VALVES

"You have confidence in us..."

"...and we have confidence in you!"

Yes, we have great faith in the ability and daring of our paratroops. They have already proven themselves in North Africa... and they may soon be dropping in on Berlin!

Our fighting men have confidence that the "soldiers of production" will do their part back home. Let's justify the confidence they are placing in us... every day, every hour... till the war is won!

Garlock

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Manufacturers of GARLOCK Packings, Gaskets and KLOZURE Oil Seals

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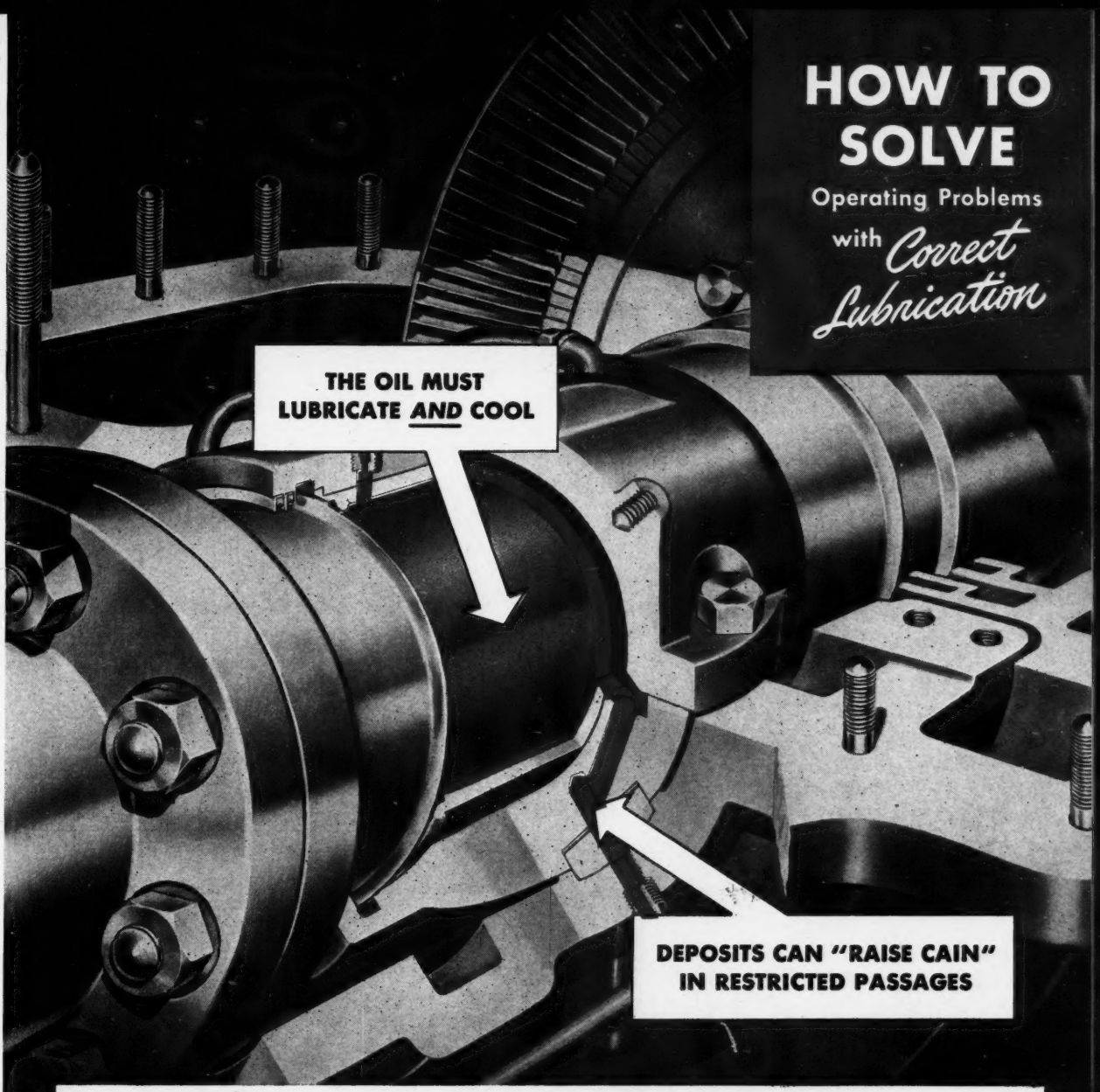
ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

HOW TO SOLVE

Operating Problems with *Correct Lubrication*



Use "Character" Analysis!

PROBLEM: Selecting turbine oil is a major decision. For only an oil film stands between safe operation and possible destruction of the turbine. The oil must maintain a high chemical stability over a long period of service, because deposits resulting from oil oxidation may interfere with free oil flow through the bearing and governing apparatus. This will cause higher operating temperatures, rapid oxidation, even disastrous bearing failure.

ANSWER: The most dependable way to foretell what a turbine oil will do is to analyze its character. *What has it done for others over a long period?* Gargoyle D. T. E.'s are used in over 50% of U. S. A.'s major-sized turbines and have service records of over 120,000 hours in a single turbine. It has been *proved* that their chemical stability assures trouble-free lubrication. These oils are far-and-away your wisest and safest choice.

GARGOYLE Lubricants

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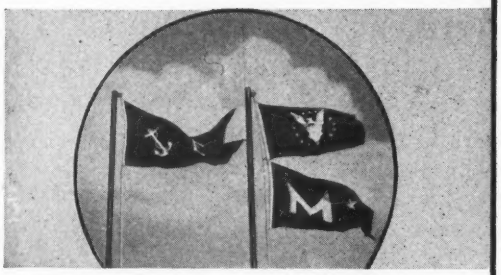
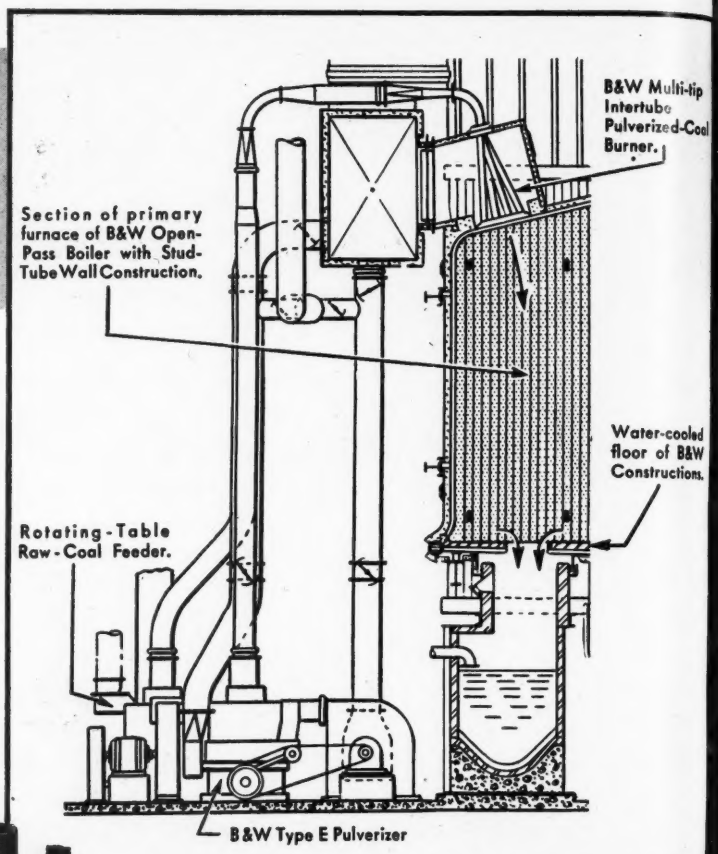
CALL IN SOCONY-VACUUM

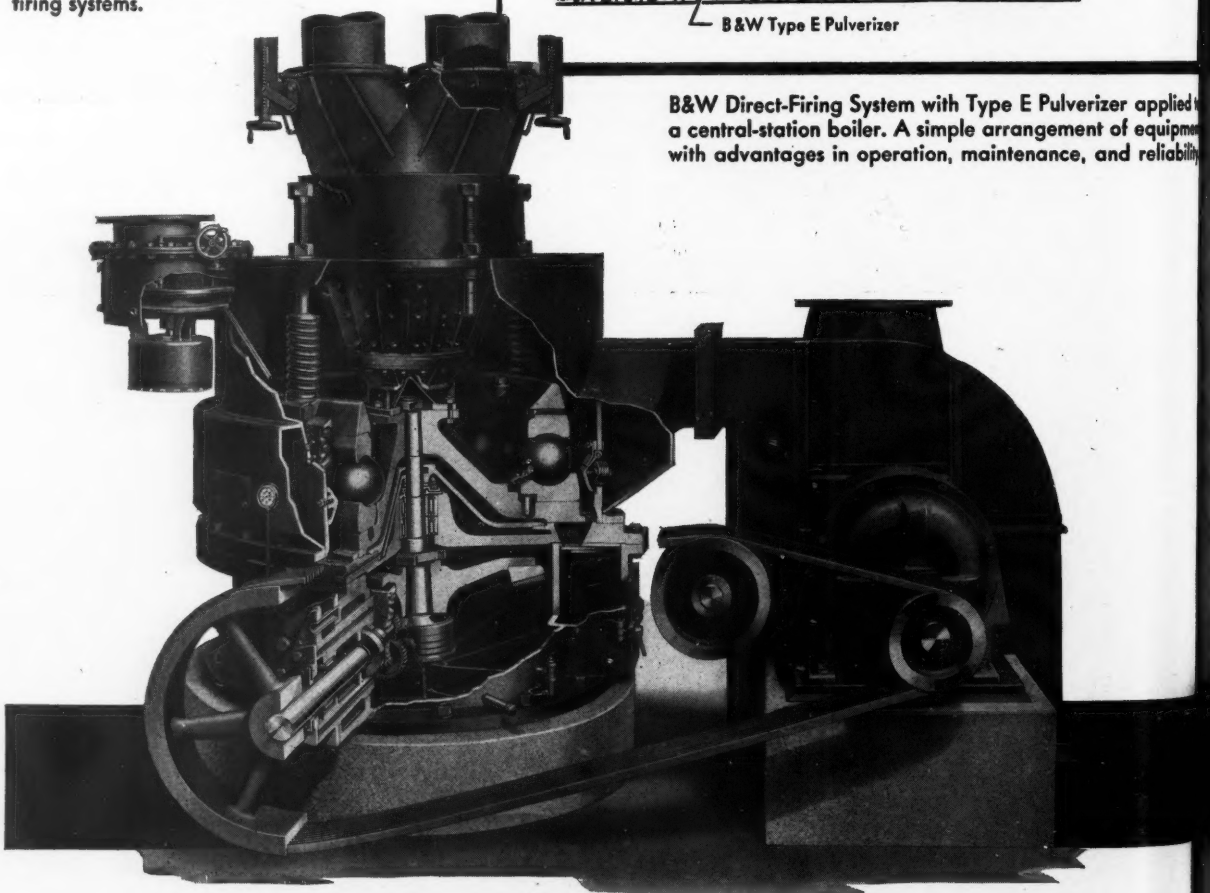


The Maritime Victory flag and "M" burgee now float proudly alongside the Navy "E" at the Barberton Works. Each is an award for "outstanding achievement" and is "an honor not lightly bestowed".


B&W Multi-tip Intertube Pulverized-Coal Burner.
Section of primary furnace of B&W Open-Pass Boiler with Stud-Tube Wall Construction.
Water-cooled floor of B&W Constructions.
Rotating-Table Raw-Coal Feeder.
B&W Type E Pulverizer

B&W Direct-Firing System with Type E Pulverizer applied to a central-station boiler. A simple arrangement of equipment with advantages in operation, maintenance, and reliability.

B&W Type E Pulverizer, with ball-bearing principle of grinding, for economy and reliability in direct-firing systems.



B&W

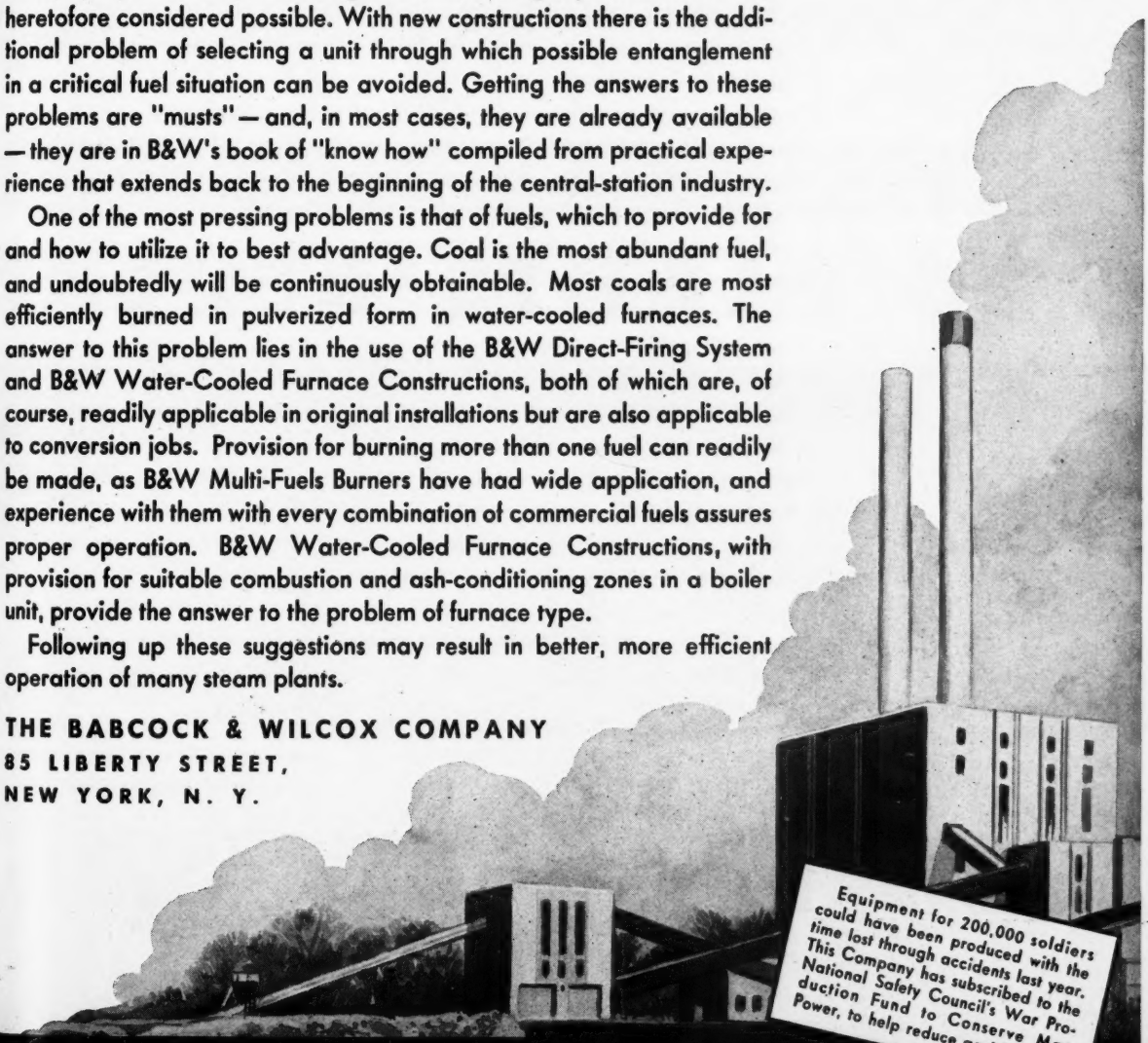
Skill and Experience can Help You with your Steam-generating Problems

Wartime operation of steam plants has brought many problems, the most general being those of how to get the most steam from existing equipment, and how to continue doing so for even longer periods than were heretofore considered possible. With new constructions there is the additional problem of selecting a unit through which possible entanglement in a critical fuel situation can be avoided. Getting the answers to these problems are "musts"—and, in most cases, they are already available—they are in B&W's book of "know how" compiled from practical experience that extends back to the beginning of the central-station industry.

One of the most pressing problems is that of fuels, which to provide for and how to utilize it to best advantage. Coal is the most abundant fuel, and undoubtedly will be continuously obtainable. Most coals are most efficiently burned in pulverized form in water-cooled furnaces. The answer to this problem lies in the use of the B&W Direct-Firing System and B&W Water-Cooled Furnace Constructions, both of which are, of course, readily applicable in original installations but are also applicable to conversion jobs. Provision for burning more than one fuel can readily be made, as B&W Multi-Fuels Burners have had wide application, and experience with them with every combination of commercial fuels assures proper operation. B&W Water-Cooled Furnace Constructions, with provision for suitable combustion and ash-conditioning zones in a boiler unit, provide the answer to the problem of furnace type.

Following up these suggestions may result in better, more efficient operation of many steam plants.

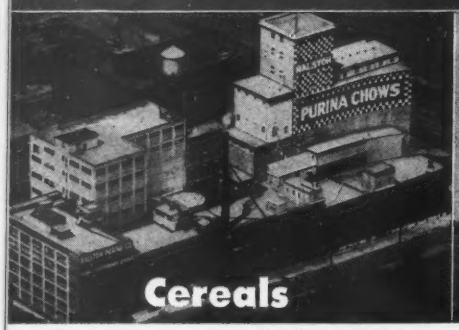
THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET,
NEW YORK, N. Y.


Equipment for 200,000 soldiers could have been produced with the time lost through accidents last year. This Company has subscribed to the National Safety Council's War Production Fund to Conserve Man Power, to help reduce accidents.

BABCOCK & WILCOX

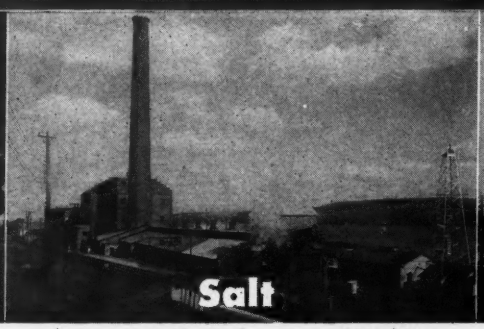
G237-T

"FOOD WILL HELP



Cereals

Ralston Purina Co., St. Louis, Mo. Nine contracts for seven plants. Total nine stokers.



Salt

International Salt Co., Watkins Glen, N. Y. Four Detroit Stokers —"Well pleased".

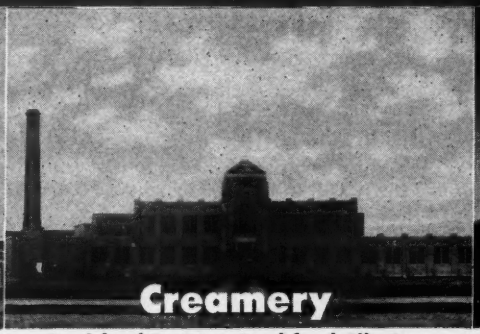
Evaporated Milk

Nestles Milk Products, Inc., Marysville, Ohio. One of five plants using twelve Detroit Stokers.

FOOD PLANTS DEPEND

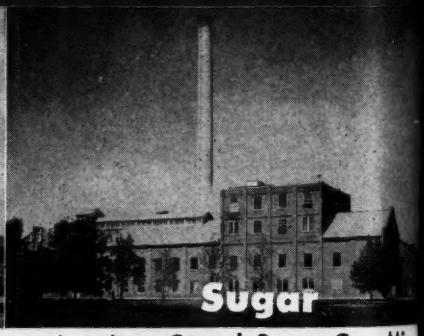
Baking

Ward Baking Co., Detroit, Mich. One of five plants equipped with Detroit Stokers.



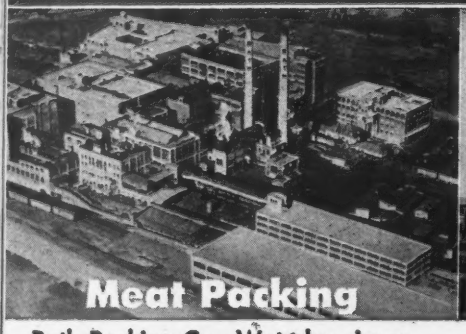
Creamery

Rockford Dairies, Rockford, Ill. One of five "Dean" Milk Plants using Detroit Stokers.



Sugar

American Crystal Sugar Co., Missoula, Mont. Use nine Detroit Stokers in three plants.

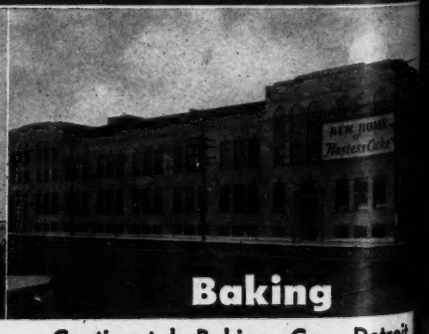


Meat Packing

Rath Packing Co., Waterloo, Iowa. One Detroit Stoker—capacity 90,000 pounds steam.

Preserves, Spices, Etc.

The Crosse & Blackwell Co., Baltimore, Md. Have used Detroit Stokers since 1927.

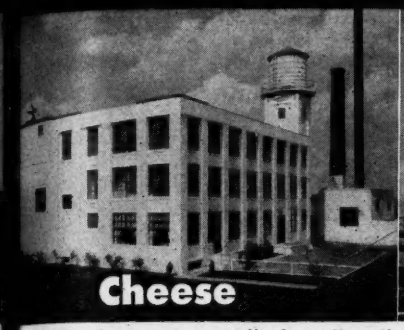


Baking

Continental Baking Co., Detroit, Mich. Seventeen Plants use twenty Detroit Stokers.

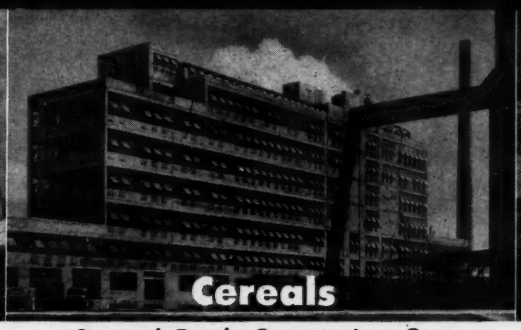
WIN THE WAR"

CLAUDE R. WICKARD, SECY. OF AGRICULTURE



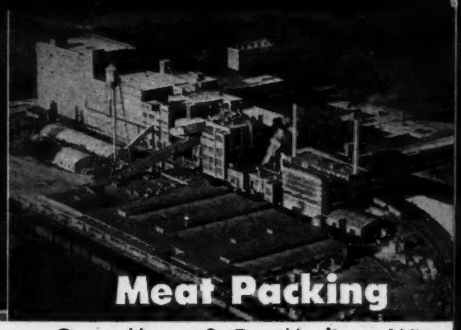
Cheese

Kraft Cheese Co., Milledgeville, Ill. Detroit Stokers used in six Kraft Cheese plants.



Cereals

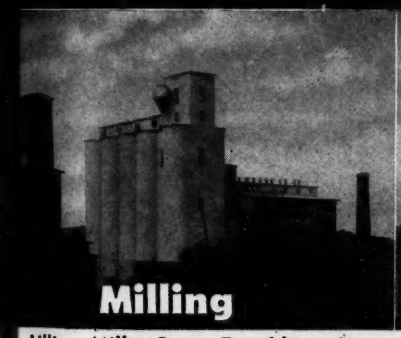
General Foods Corporation, Corn Mill Division, Kankakee, Illinois. Uses Detroit Stokers.



Meat Packing

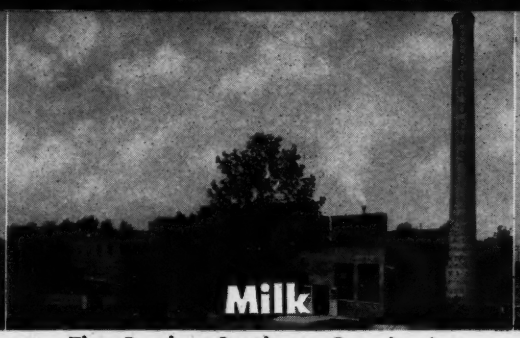
Oscar Mayer & Co., Madison, Wis. One Detroit Stoker—capacity 75000 pounds of steam per hour.

UPON DETROIT STOKERS



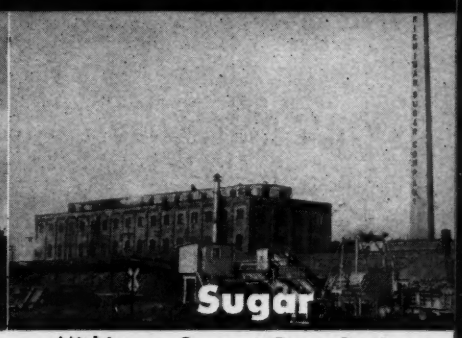
Milling

Lillie Mill Co., Franklin, Tenn. Used a Detroit Stoker since 1928. "Well satisfied".



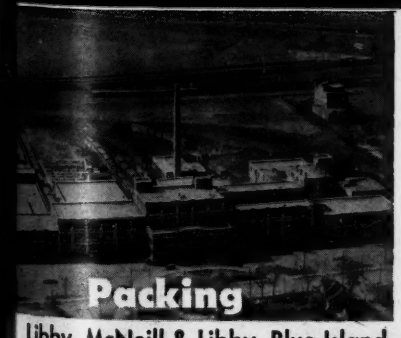
Milk

The Borden Southern Co., Lewisburg, Tenn. One of fifteen Borden plants using thirty-one stokers.



Sugar

Michigan Sugar Co., Saginaw, Mich. Nineteen Stokers in six plants —capacity 800,000 pounds steam.



Packing

Libby, McNeill & Libby, Blue Island, Ill. Eight Detroit Stoker contracts for five plants.

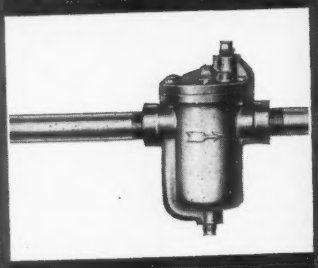
Soldiers and Workers must be fed. More Food means more Steam. Detroit Stokers contribute by handling heavier loads, and in successfully burning and conserving coal, "The Nation's Basic Fuel". Write for Bulletin 524.

DETROIT STOKER COMPANY

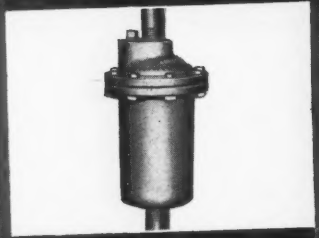
Fifth Floor, General Motors Building, Detroit, Michigan
Works at Monroe, Mich. • District Offices in Principal Cities
Built in Canada at London, Ontario

STEAM is Precious

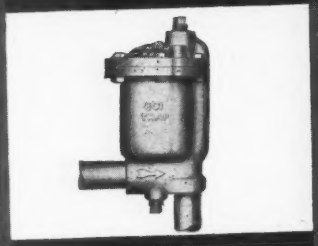
For Neatest Possible Hook-ups and Minimum Piping



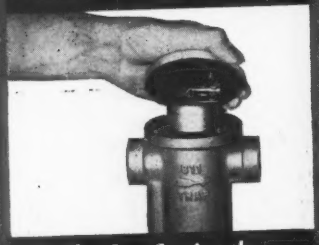
Side Inlet -- Side Outlet



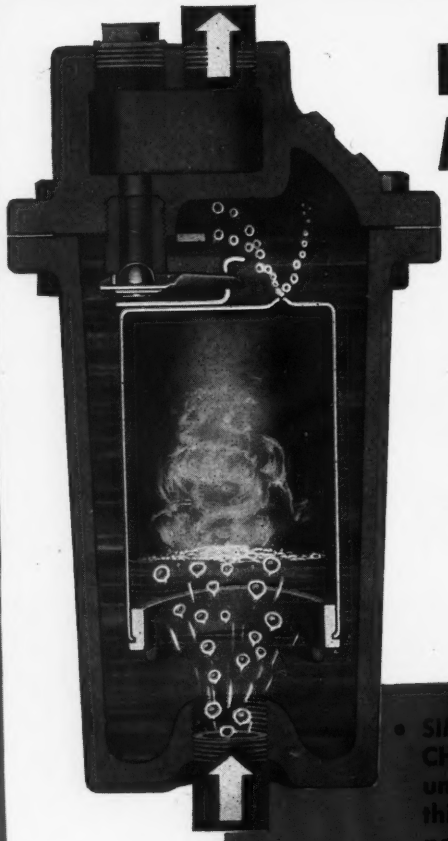
Bottom Inlet -- Top Outlet



Side Inlet -- Bottom Outlet



The Cap Carries the Whole Works



HERE IS WHY ARMSTRONG TRAPS ARE YOUR *Wisest Choice*

- SIMPLE, DEPENDABLE INTERIOR MECHANISM. First developed to meet unusually severe service conditions, this construction is now standard at no extra cost.
- HEAT TREATED VALVE AND SEAT. The same quality and special alloy composition as used in Armstrong traps for 1500 lbs. pressure.
- INDIVIDUALLY TESTED. Even traps for lowest pressures have close grain, semi-steel bodies and are tested with a minimum hydraulic pressure of 500 lbs. per sq. in. Valves and seats are lapped together for maximum tightness.
- ADVANCED DESIGN. Free-floating valve, no fixed pivots to wear, no narrow clearances. Positive valve action—wide opening, tight closing. No steam leakage with light loads. Non air-binding . . . self-scrubbing . . . big capacity!

ARMSTRONG TRADE MARK "INVERTED BUCKET" STEAM TRAP

Armstrong

THESE DAYS . . .

MAKE THE MOST OF IT WITH *Good* TRAPPING

THE SCOREBOARD

PENALTIES OF POOR TRAPPING	GAINS FROM GOOD TRAPPING
STEAM AND FUEL WASTE	The Midland Chemical Laboratories, Inc., Dubuque, Iowa, cut fuel oil consumption over 40,000 gal. per year by installing 16 Armstrong Traps and some new piping.
WASTE OF BOILER CAPACITY	The Bestovall Canning Co., Ltd., Vancouver, B. C., ordered a new 65 H. P. boiler, then found it wasn't needed when 7 Armstrong Traps were installed.
WASTE OF MANPOWER	R. Thomas & Sons Co., Lisbon, Ohio, saved 19 man days per month maintenance time after installing 50 Armstrong Traps.
LOSS OF TIME AND OUTPUT	Bulman's Ltd., Vernon, B. C., was able to bring cooking kettles to a boil in 30% less time after they were unit trapped with Armstrongs.

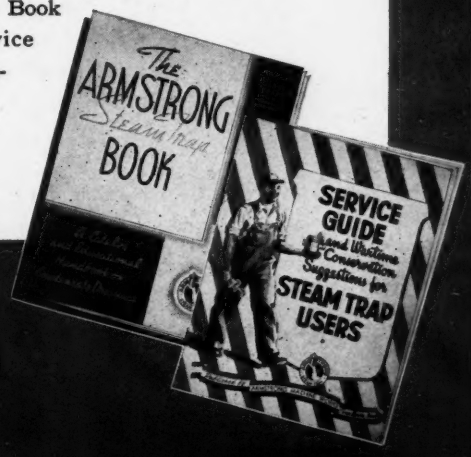
IN terms of time, fuel, metal, manpower and money that goes into its production and utilization, steam for war production, becomes a precious commodity these days. Inefficient use of steam represents a serious drain on America's production capacity.

Armstrong Steam Traps are noted steam savers. They eliminate the steam leakage which is permitted by faulty drainage devices. As much as 835,000 lbs. of steam at 100 lbs. pressure can be lost through a ½" orifice in a month.

Armstrong Traps automatically eliminate air. One half of 1% by volume of air mixed with steam can cause a reduction in heat transfer efficiency of 50% according to one authority.

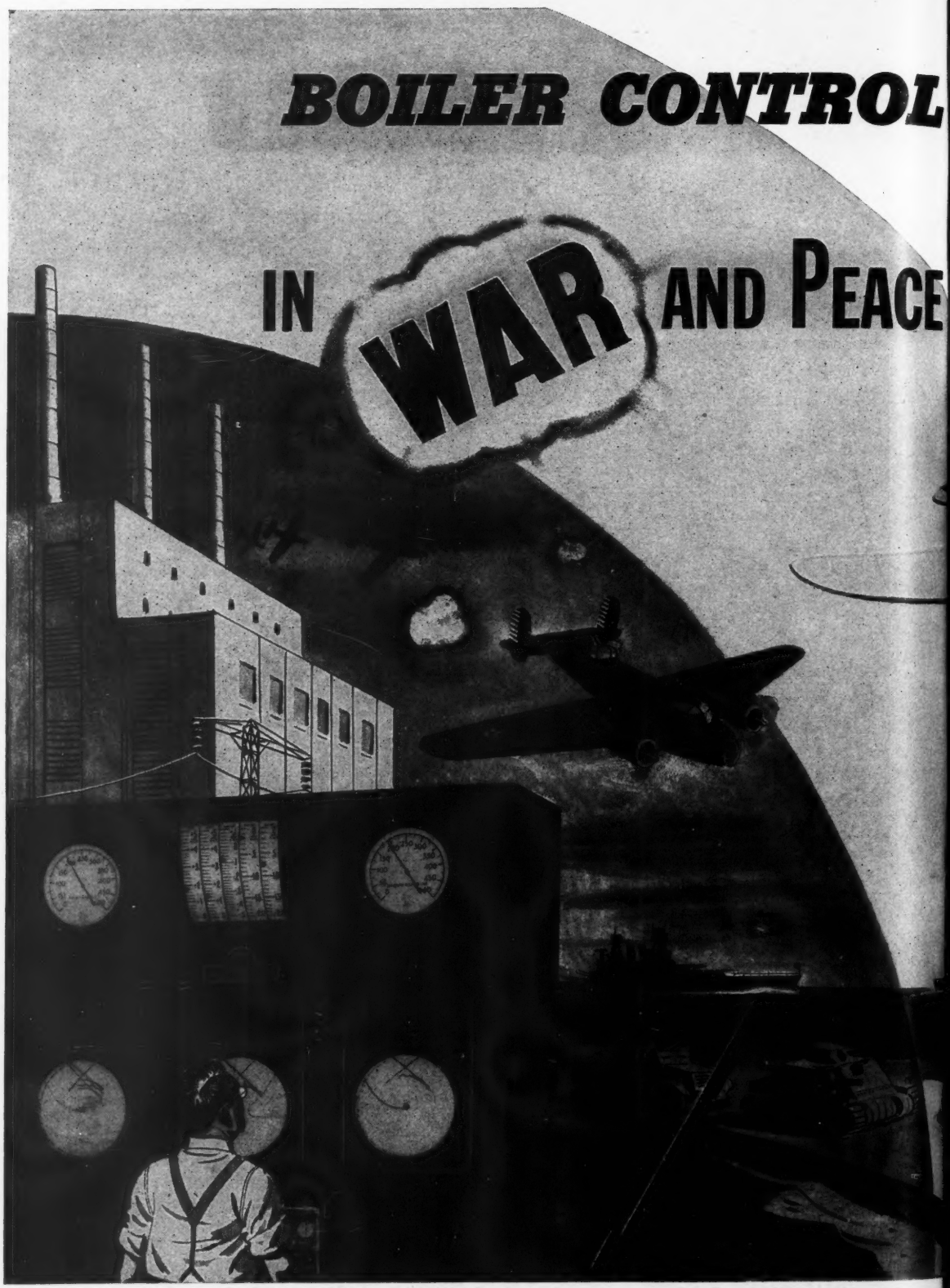
At the same time, Armstrong Traps speed up heating and output by eliminating all condensate as fast as it forms regardless of load conditions.

For complete information on Armstrong Traps for your plant, write today. Ask for the Armstrong Steam Trap Book and the new Service Guide on trap maintenance.



ARMSTRONG MACHINE WORKS
810 Maple Street • Three Rivers, Michigan

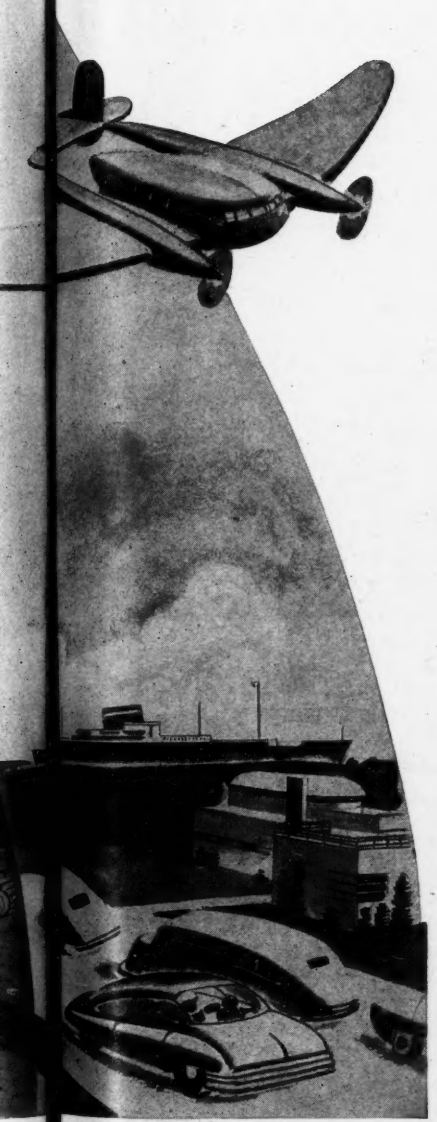
STEAM TRAPS



BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERH

SPEEDS PRODUCTION



★ ★ ★

The same Bailey Boiler Control which is today helping American industry to deliver a flood of war material will continue to serve its users after the war.

When raw materials again flow to the goods of peace, this complete boiler control system will help many fortunate manufacturers to produce better products at lower cost.

But now, Bailey Control serves the war effort by:

1. Improving Continuity of service by continuously maintaining Combustion, Feed Water Flow, Steam Temperature, Heater Levels, Pump Pressure and other factors at optimum values.
2. Making full boiler capacity available by continuously and automatically maintaining excess air at the minimum economical value and by indicating when cleaning or repairs are necessary for boilers and furnaces.
3. Automatically maintaining ideal conditions while new boiler operators are in training.
4. Easing of transportation loads by the economical use of fuel which results from a co-ordinated control system.
5. Protecting men and equipment against accidents by the use of interlocks and alarms in the boiler control system. Serious accidents resulting from fan failure, flame failure, high or low water levels and other unusual conditions may be avoided by these devices.

Numerous suggestions on War Time Boiler Plant Operation are contained in the bulletin, "How to Safely Stretch Steaming Capacity." To obtain a copy, simply ask for Bulletin No. 16.

A-85

BAILEY METER COMPANY

1028 IVANHOE ROAD • CLEVELAND, OHIO

Bailey Meter Company Limited, Montreal, Canada

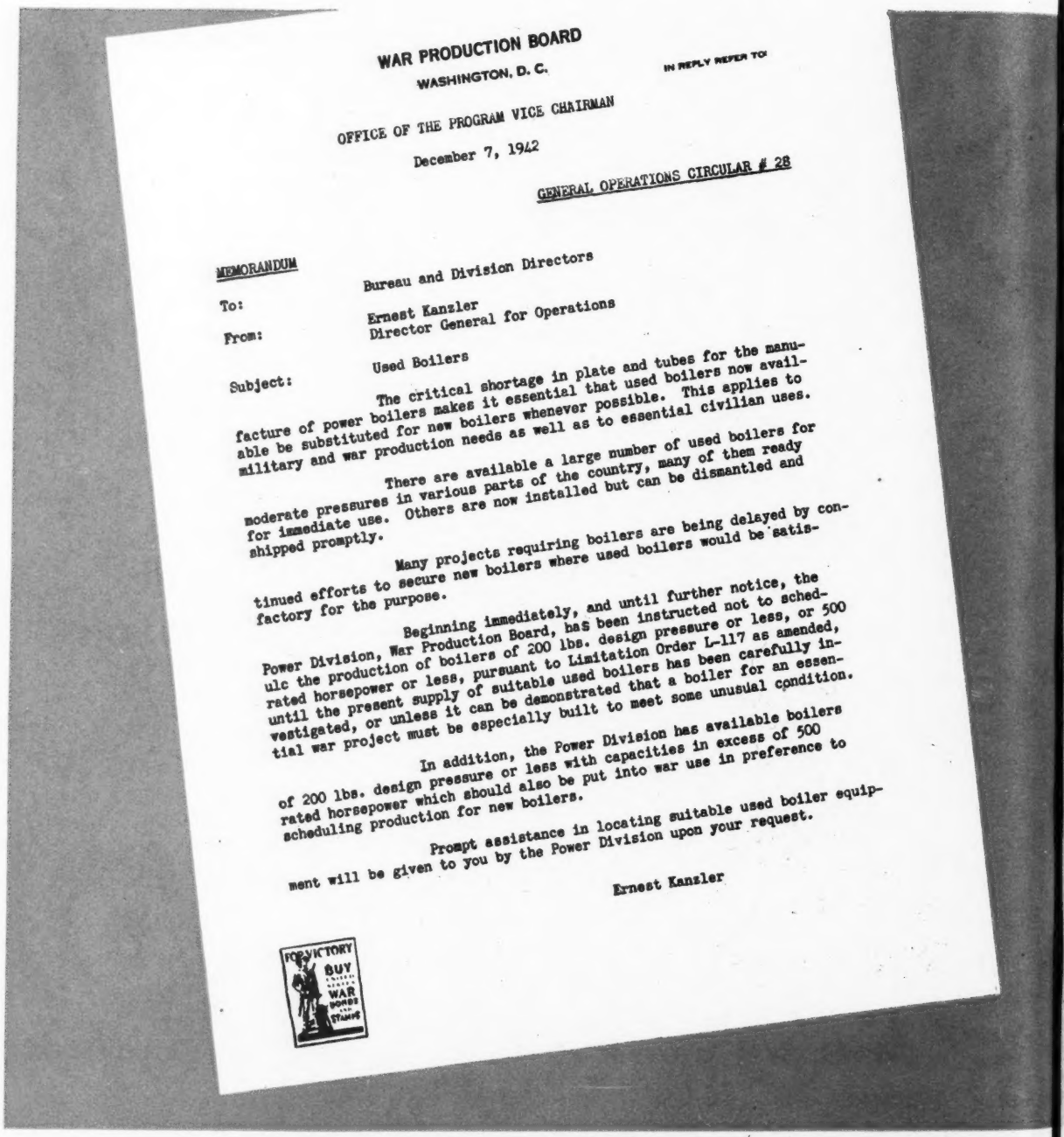
The Complete Combustion Control System

DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

EVERY PARAGRAPH OF THIS

. . . is of immediate importance to

BOILER USERS



WAR PRODUCTION BOARD

WASHINGTON, D. C.

IN REPLY REFER TO:

OFFICE OF THE PROGRAM VICE CHAIRMAN

December 7, 1942

GENERAL OPERATIONS CIRCULAR # 28

MEMORANDUM

To: Bureau and Division Directors

From: Ernest Kanzler
Director General for Operations

Subject: Used Boilers

The critical shortage in plate and tubes for the manufacture of power boilers makes it essential that used boilers now available be substituted for new boilers whenever possible. This applies to military and war production needs as well as to essential civilian uses.

There are available a large number of used boilers for moderate pressures in various parts of the country, many of them ready for immediate use. Others are now installed but can be dismantled and shipped promptly.

Many projects requiring boilers are being delayed by continued efforts to secure new boilers where used boilers would be satisfactory for the purpose.

Beginning immediately, and until further notice, the Power Division, War Production Board, has been instructed not to schedule the production of boilers of 200 lbs. design pressure or less, or 500 rated horsepower or less, pursuant to Limitation Order L-117 as amended, until the present supply of suitable used boilers has been carefully investigated, or unless it can be demonstrated that a boiler for an essential war project must be especially built to meet some unusual condition.

In addition, the Power Division has available boilers of 200 lbs. design pressure or less with capacities in excess of 500 rated horsepower which should also be put into war use in preference to scheduling production for new boilers.

Prompt assistance in locating suitable used boiler equipment will be given to you by the Power Division upon your request.

Ernest Kanzler

FOR VICTORY BUY WAR BONDS AND STAMPS

WPB MEMORANDUM . . .

WHAT TO DO ABOUT IT

1 If you need additional boiler capacity

You can save a lot of time and trouble by getting in touch with Power Division, War Production Board, Washington, D. C. This division controls not only the boiler plate schedules of the mills but also the shop schedules of all boiler manufacturers.

If you want a boiler of not over 500 rated hp and not over 200 lb design pressure, in all probability you will be referred to the Used Equipment & Machinery Branch, Redistribution Division, where information on several thousand second-hand boilers is available for your inspection. You may select a boiler to meet your conditions and negotiate with the owner. Upon completion of negotiations, you must obtain release and authority to purchase from the Power Division of WPB, on Form PD-677.

If your requirements are beyond the limits of available used boilers, **WPB will advise you whether your needs entitle you to purchase a new boiler.** If your application to do so is approved, you may proceed in the usual manner to get quotations and make your purchase from whatever boiler manufacturer you choose.

2 If you have spare boiler capacity

Your Government is interested in getting information on any boilers that can be spared in sizes ranging from 35 hp up with operating pressures from 15 lb up. Somewhere there is a plant that can put to much-needed use just such a boiler as you may be able to release.

If you have one or more boilers you can spare, notify the War Production Board, Used Equipment & Machinery Branch, Redistribution Division, Washington, D. C. Give type of boiler, its present location, steam pressure, rated horsepower, name and address of owner and briefly describe its general condition, age, etc. Your boiler will then be listed in the Government records of available used equipment and anyone interested in its purchase can get in touch with you.

It is a patriotic duty of the first order to help place needed equipment where it will serve a vital war purpose. Therefore, don't delay to notify the Government if you have one or more boilers you can get along without.

3 If you want "in-the-field" assistance with your problem

Perhaps there is some aspect of your problem you would like to discuss. C-E representatives throughout the country are generally familiar with the regulations and procedures. They will be glad to assist you in any way they can. Addresses and 'phone numbers are as follows:

Birmingham, Ala., Martin Bldg. ..... *Birmingham 4-1708*
Boston, Mass., Chamber of Commerce Bldg. ..... *Hancock 6650*
Charlotte, N. C., Independence Bldg. ..... *Charlotte 2-1228*
Chattanooga, Tenn., 1032 West Main St. ..... *Chattanooga 7-1221*
Chicago, Ill., Bankers Bldg. ..... *Randolph 2417*
Cincinnati, Ohio, Gwynne Bldg. ..... *Cherry 6735*
Cleveland, Ohio, Guardian Bldg. ..... *Main 5364*
Denver, Colorado, 1940 Blake St. ..... *Main 4818*
Detroit, Mich., Book Bldg. ..... *Randolph 7546*
Hazleton, Pa., Markle Bank Bldg. ..... *Hazleton 1090*
Houston, Texas, Mellie Esperson Bldg. ..... *Fairfax 8206*
Kansas City, Mo., Board of Trade Bldg. ..... *Harrison 3011*
Los Angeles, Calif., Architects Bldg. ..... *Michigan 8571*
Minneapolis, Minn., Plymouth Bldg. ..... *Geneva 1820*
New York, N. Y., 200 Madison Ave. ..... *Lexington 2-1500*
Philadelphia, Pa., 1616 Walnut St. ..... *Pennypacker 7020*
Pittsburgh, Pa., First National Bank Bldg. ..... *Atlantic 1510*
Portland, Ore., 3019 N. E. 26th Ave. ..... *Atwater 6444*
St. Louis, Mo., 5319 Shreve Ave. ..... *Goodfellow 5600*
Salt Lake City, Utah, 210 So. West Temple St. ..... *Salt Lake City 5-1242*
San Francisco, Calif., Monadnock Bldg. ..... *Garfield 8315*
Seattle, Wash., 1411 Fourth Ave. ..... *Elliott 6662*
Spokane, Wash., 3219 Wellington Place ..... *Broadway 0572*
Tacoma, Wash., Tacoma Bldg. ..... *Main 4281*

NOTE: **If you purchase a used boiler, we can help you with modern firing equipment that will enable you to get the most out of it. Call on our nearest district office.**

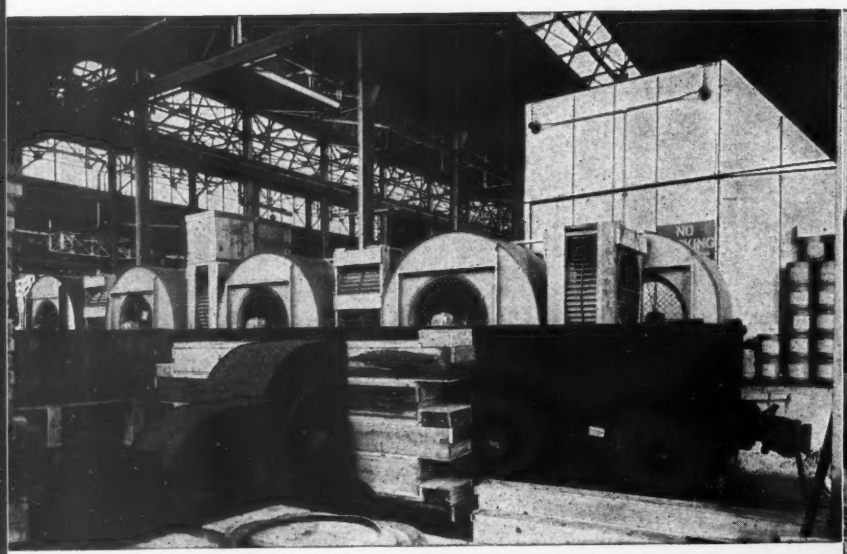
A-708

COMBUSTION ENGINEERING

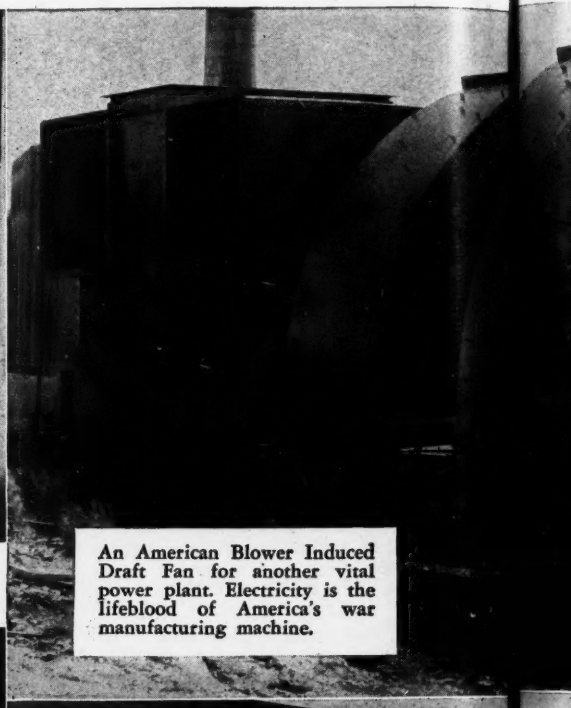
COMPANY, INC. • 200 MADISON AVENUE, NEW YORK, N. Y.

AMERICAN BLOWER "KEEPS'E

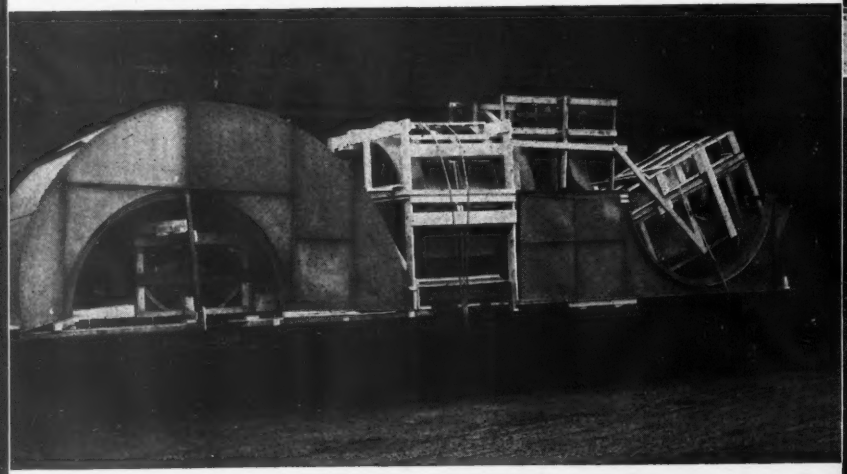
CARLOAD AFTER CARLOAD OF POWER EQUIPME



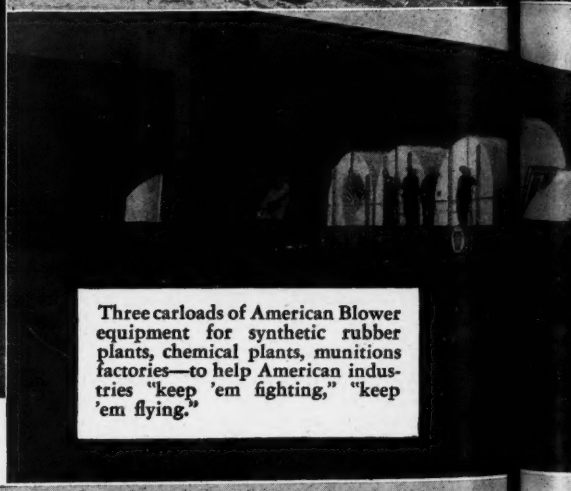
Global war throws a tremendous burden on a shipbuilding program. Photo above shows one of hundreds of cars of Sirocco Forced Draft Fans for U. S. Maritime Commission ships.



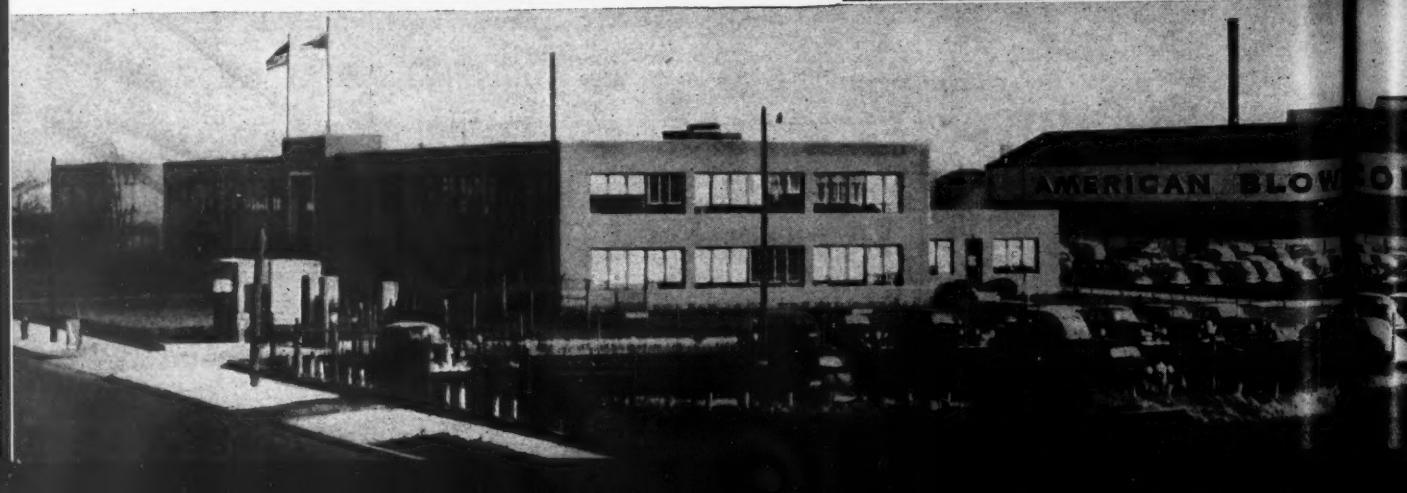
An American Blower Induced Draft Fan for another vital power plant. Electricity is the lifeblood of America's war manufacturing machine.



This heavy duty American Blower Forced Draft Fan is on its way to one of America's vital "producers of power"—will soon be helping to generate electricity to build more bombs and bullets, battleships and other war material.



Three carloads of American Blower equipment for synthetic rubber plants, chemical plants, munitions factories—to help American industries "keep 'em fighting," "keep 'em flying."



'S 'EM ROLLING"

IPMENT FOR VICTORY!

Heavy duty wheels, bearings and shafts, enroute to a vital smelter.

HATS OFF to American Utilities and American Industry! Your combined efforts have more than met the challenge of the Axis. Now, you are outproducing them in planes, tanks, trucks, guns, bullets, bombs and ships.

You've got WHAT IT TAKES TO WIN!

We of American Blower know the miracles you have performed to reach the present peaks of war production. We know what you are going through to step up these peaks again and again.

We're proud that we have been privileged to work with you for this great Cause, privileged to build much of the Mechanical Draft Equipment, Fans, Blowers, Fluid Drives, and other vital parts that have helped to "keep 'em rolling" for Victory.

ARMY E NAVY

MECH. DRAFT · AIR-CONDITIONING AMERICAN BLOWER FLUID DRIVES · DUST COLLECTORS

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of AMERICAN Radiator and Standard Sanitary Corporation

General offices, research and engineering buildings, and manufacturing plant of American Blower Corporation at Dearborn, Michigan. Other plants — Columbus, Ohio, Detroit, Michigan, and Windsor, Ontario.

THESE RESULTS JUSTIFY YO
IN A-E-CO TAYLOR SY

PROBLEM: The manufacturing plant concerned is located in an area adjacent to fields offering coals of widely diversified burning characteristics. The problem, therefore, was to select fuel firing equipment that could take advantage of most favorable situations under fluctuating market conditions, and at the same time deliver maximum efficiency and reliability.

SOLUTION: Comparison of many possible combinations of equipment led to the choice of a modern Taylor Continuous Ash Discharge Stoker-fired Steam Generator. The completed unit consisted of a Taylor Stoker driven by an integral steam turbine—all under a 472 H.P. straight tube boiler with vertical side and rear water-walls. Relatively low cost of coal precluded the necessity for heat recovery equipment.

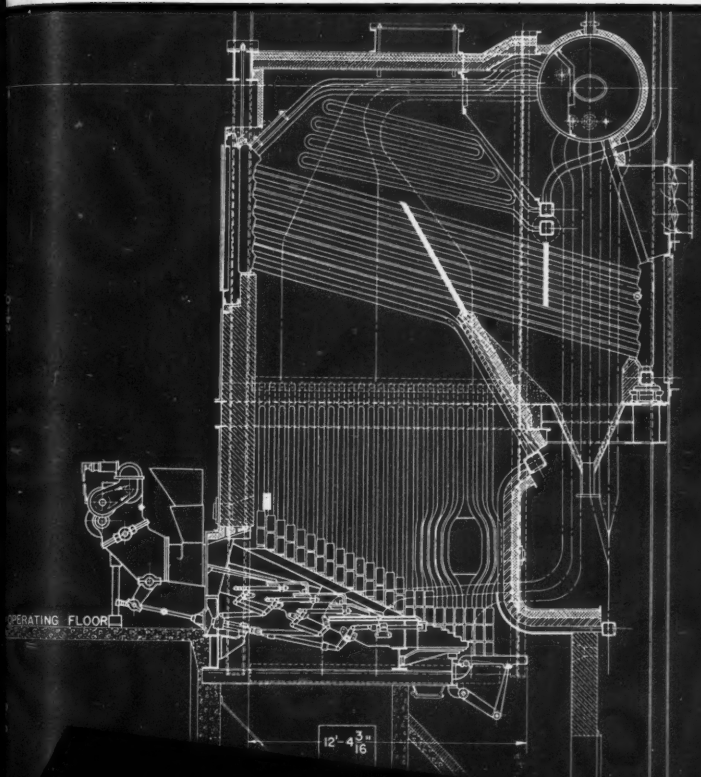
RESULTS: The unit was placed in service in 1940. Since the first day of operation the overall efficiency has averaged 79.8% without heat recovery devices. Records of performance dating from December 25, 1940 to September 8, 1942, reveal 206,286,000 lbs. of steam generated while burning 20,030,000 lbs. of coal. Average actual evaporation was 10.3 lbs. coal/lb. steam. Average gauge pressure 214 lbs. Average steam temperature 510°F. Average feed water temperature 224°F. Average B.T.U. per lb. coal as fired 13,900. Steaming rates ranged from 10,000 to 34,000 lbs. per hour.

ANOTHER CASE IN THE METAL WORKING INDUSTRIES

AMERICAN ENGINEERING

PHILADELPHIA • PENNSYLVANIA

YOUR CONFIDENCE IN A-E-CO TAYLOR STOKERS!



A-E-CO TAYLOR STOKERS ON THE FIRING LINE

*Aluminum Company of America, Edgewater, N. J.
*Aluminum Company of America, New Kensington, Pa.
American Tobacco Co., Inc., Durham, N. C.
Castanea Paper Company, Johnsonburg, Penna.
Chrysler Corporation, DeSoto Plant, Detroit, Mich.
*Collins and Aikman Corp., Roxboro, N. C.
City of Columbus, Ohio
*Consolidated Paper Company, Monroe, Michigan
*Cresson State Sanitarium, Cresson, Penna.
Defiance Milk Products Co., Defiance, Ohio
*DeLaval Steam Turbine Co., Trenton, N. J.
*Detroit Sulphite Pulp & Paper Co., Detroit, Michigan
City of Dover, Ohio
*Draper Corporation, Hopedale, Mass.
Erwin Cotton Mills Co., West Durham, N. C.
*Fisher Body Corporation, Detroit, Michigan
Fisher Body Corporation, Fleetwood Plant, Michigan
*Fisher Body Corporation, Grand Rapids, Michigan
*Fisher Body Corporation, Pontiac, Michigan
Fox Paper Company, Lockland, Ohio
Froedtert Grain and Malting Co., Milwaukee, Wisc.
*City of Galion, Ohio
*Gardner-Richardson Company, Lockland, Ohio
*General Electric Company, Erie, Penna.
*General Electric Company, Fort Wayne, Ind.
*Greenwood Electric L. & W. Plant, Greenwood, Miss.
*Board Public Works, Hannibal, Mo.
Hill School, Pottstown, Penna.
*Hobart Mfg. Co., Troy, Ohio
*City of Holland, Michigan
*Hope Natural Gas Co., Cornwell Station, West Va.
Hudepohl Brewing Co., Cincinnati, Ohio
Industrial Cotton Mills, Rock Hill, S. C.
*City Water & Light Plant, Jonesboro, Ark.
Kohler Company, Kohler, Wisc.
Maryland State Penal Farm, Roxbury, Md.
*Maybury Sanitarium, Northville, Michigan
Michigan Carton Company, Battle Creek, Michigan
*Michigan State College, East Lansing, Mich.
Municipal Light Plant, Marshfield, Wisc.
*Pacific Mills, Lyman, S. C.
*Packard Motor Car Co., Detroit, Michigan
*Municipal Electric Plant, Painesville, Ohio
*Park Drop Forge, Cleveland, Ohio
*Pennsylvania Electric Co., Seward, Penna.
*Pennsylvania R. R. Co., Philadelphia, Penna.
*Picatinny Arsenal, Dover, N. J.
*Pittsburgh Plate Glass Co., Barberton, Ohio
Borough of Quakertown, Quakertown, Penna.
Raleigh Wyoming Mining Co., Glen Rogers, W. Va.
*Rhinelander Paper Company, Rhinelander, Wisc.
City of Richland Center, Wisconsin
*City of Richmond, Indiana
Sarles Biltmore Bleachery, Biltmore, N. C.
Scotten Dillon Company, Detroit, Michigan
Shelby Cotton Mills, Shelby, N. C.
Sloane-Blabon Corp., Philadelphia, Penna.
*Solvay Process Company, Detroit, Michigan
*St. Elizabeth's Hospital, Washington, D. C.
City of St. Bernard, Ohio
Swarthmore College, Swarthmore, Penna.
*Timken Roller Bearing Co., Canton, Ohio
Timken Roller Bearing Co., Gambrinus, Ohio
Municipal Water & Light Plant, Tippecanoe City, O.
City of Toledo, Ohio
*Union Bleachery, Greenville, S. C.
Union Mills Paper Mfg. Co., New Hope, Penna.
*University of Wisconsin, Madison, Wisc.
*Vassar College, Poughkeepsie, New York
*Borough of Vineland, New Jersey
Warfield Natural Gas Company, Harold, Kentucky
White Sewing Machine Co., Cleveland, Ohio
Whiting Plover Paper Company, Stevens Point, Wisc.

(*) *Represents repeat orders.*

A-E-CO TAYLOR STOKER

A-E-CO TAYLOR STOKERS
WATER WALLS-ASH HOPPERS
HELE-SHAW FLUID POWER
MARINE DECK AUXILIARIES
LO-HED HOISTS

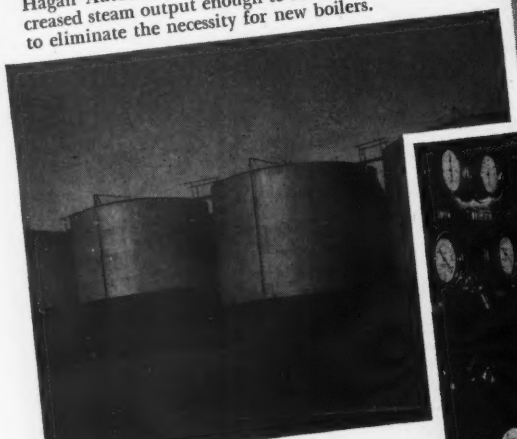
COMPANY

BEFORE YOU BUY ANY FUEL FIRING EQUIPMENT CONSIDER EACH OF THESE 12 FACTORS

1. **RELIABILITY**—the ability to operate with minimum outage and minimum standby equipment.
2. **CAPACITY**—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.
3. **MAINTENANCE**—the ability to operate continuously with minimum repair costs.
4. **FLEXIBILITY**—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.
5. **EFFICIENCY**—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.
6. **OPERATION**—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.
7. **ADAPTABILITY**—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.
8. **FUEL FLEXIBILITY**—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.
9. **REFUSE DISPOSAL**—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.
10. **STACK DISCHARGE**—the practical elimination of "smoke nuisance" without special equipment.
11. **SPACE REQUIREMENTS**—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.
12. **OBSOLESCENCE**—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

Our Hagan investment

STEPS UP STEAM OUTPUT
Hagan Automatic Combustion Control has often increased steam output enough to handle peak loads and to eliminate the necessity for new boilers.



STRETCHES FUEL SUPPLIES
Hagan-equipped plants are helping to reduce the fuel shortage.

HELPS MANPOWER PROBLEM
Hagan Automatic Control permits plants to operate at high efficiency with the minimum number of men. New men can be broken in easily because the operators are relieved of a myriad of duties.

STAR PERFORMER IN A BLACKOUT
Blackouts are no serious problem for a plant equipped with Hagan Control. The control can carry on by itself and allow the operator to take care of other duties.

Control was the best we ever made

- **It helped us lick the steam problem for war production.**
- **It will pay for itself over and over again in the years to come.**

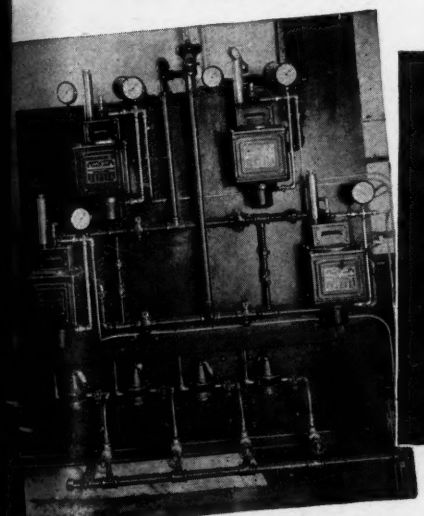
IT is not often you can make an investment that pays off in two ways, but here is one that thousands of Hagan users would tell you will.

For Hagan Control will not only meet your urgent need for increased steam efficiency *today*, but the economies it will effect in fuel consumption, labor and maintenance costs will pay rich returns for many years to come. No other type of equipment we know will write off its cost so quickly.

We can show you Hagan systems which have been giving good service so long we have almost forgotten when they were sold. We can tell you of hundreds of customers whose expansion through the years has included additional Hagan installations.

We are proud of these "old-timers;" they so fully justify our engineers' insistence on mechanical perfection.

Right now your plant is probably facing the severest test it has ever known or may ever undergo again. You are up against skilled labor and materials shortage. Satisfactory automatic control is a positive "must." These needs alone justify the investment. But Hagan Control will do more than satisfy today's need. Year in and year out its economies will pay off in never-failing dividends. Let us show you how.



STANDS UP UNDER WAR LOADS
Continuous high operation puts equipment to the severest kind of test and also proves the value of sound engineering design. We're proud of Hagan "old timers" that are coming through the war loads with very little need for maintenance.

HAGAN
Automatic COMBUSTION CONTROL
The pioneer . . . and still the leader

Specific advantages of Hagan Automatic Control

HAGAN
HALL
BUROMIN
CALGON

MAXIMUM QUANTITY of steam from any given plant, by introducing fuel and air in correct proportion for utmost efficiency.
MAXIMUM UTILIZATION value, uniform steam pressure and temperature, in accordance with demand.
MAXIMUM OUTPUT from boilers of differing capacities, automatically.
MAXIMUM STEAM for production, by reducing loss of steam in frequent soot-blowing.
MAXIMUM PROTECTION of auxiliary equipment, fans, stokers, etc., by maintenance of uniform operating conditions.

HAGAN CORPORATION · HAGAN BLDG. · PITTSBURGH, PA.

Scovill Tube News

Vol. 1 SCOVILL MANUFACTURING COMPANY, Waterbury, Conn. No. 2

Checking War-Time Tube Mortality By Study of Service Conditions

The Workmanship and Quality of the Tubes

The physical and metallurgical condition of condenser and heat exchanger tubes is relatively less important as a contributing factor of corrosion than the service conditions to which they are exposed. Nevertheless, deep scratches, seams, folds, unsoundness or other serious metal imperfections in tubes may initiate corrosion of a severe electro chemical type and should be avoided. A high standard of quality in the manufacture of tubes, therefore, is required to insure freedom from this source of trouble. Each step in the production of tubes from the selection of the raw material, through the casting, to the extrusion, drawing and annealing operations requires careful supervision. Metallurgical and chemical tests are necessary both on the finished tubes and on material in process. Close cooperation is maintained between manufacturing departments and the laboratory not only for necessary control work but also for developing new processes, new corrosion-resistant alloys or for any other work leading to the technical advancement in the manufacture and use of condenser and heat exchanger tubing. A discussion of this subject would not be complete without pointing out the excellent work done by various technical organizations in setting up high standards for the purpose of guaranteeing the quality of heat exchanger tubing. As an illustration, the specification covering Copper and Copper-alloy Seamless Condenser Tubes and Ferrule Stock issued by the American Society for testing materials, designation Bill 42, may be cited. This specification covers many essential requirements for the production of satisfactory and acceptable condenser tubes.

Conditions of Service

Heat exchanger tubes may be required to withstand or resist corrosion by various media under widely varying service conditions. The rate, form and intensity of corrosion of tube materials, and hence their period of service, depends upon the predominating or controlling factor or a certain combination of factors which may be found active for each individual installation. A study and appreciation of these factors as they apply to any particular corrosion problem is necessary not only in the selection of the most satisfactory and economical tube material, but in the proper control of such factors as may be required to extend tube life. The following list covers the most important of the factors which influence corrosion:

a. Temperature (tube-wall)
b. Velocity of media in contact with tubes
c. Hydrogen Ion Concentration
d. Oxygen Concentration
e. Composition of corroding media
f. Stresses acting upon tubes
g. Contact with dissimilar metals

Scarce metals saved by accurate Condenser and Heat Exchanger facts

Firms using Scovill's Service in Manuals find it possible to increase service life of tubes by seeing that engineers get all the facts on conditions of service, types of corrosion, selection of materials, etc. — contained in Scovill's complete "Condenser Tube Booklet", now available without charge to all tube users. The article on this page — No. 2 in a series of informative bulletins — is also available in reprint form. Write Scovill Manufacturing Company, 17 Mill Street, Waterbury, Conn.

The influence of each of the above factors is considered in the following paragraphs.

a. Temperature (tube wall)

Temperature plays an important part in all chemical reactions and hence, in all corrosion problems. The speed of all chemical changes is increased by raising the temperature and diminished by lowering it. Different reactions are affected in different degrees so that no simple rule can be given which will accurately define the effect of temperature. Roughly speaking, however, a rise of 10°C. doubles the speed of a reaction. Under actual service conditions, therefore, slight increases in operating temperature may accelerate corrosion to a marked degree and may be the deciding or major factor in short tube life. A rise in temperature of media in contact with tubes increases ionization, diffusion rates and the electrical conductivity of the solution, all of which may contribute to increased corrosion. On the other hand, an increased temperature may actually de-celerate corrosion in certain cases, due to such changes in the circulating media as a loss in oxygen or other gas concentration with rising temperature, or to the rapid formation of protective films, etc. An increase in temperature from 20°C. to 35°C. more than doubles the rate of corrosion of copper in either oxygen free or oxygen saturated, 6% (by weight) sulphuric acid solution. The corrosion of mild steel and of aluminum in both 6% by weight and 50% by weight of oxygen free or oxygen saturated sulphuric acid solution is, with one exception, very markedly accelerated by an increase of 15°C.

b. Velocity

The velocity or movement of the media in contact with tubes influences

the rate of corrosion for the following reasons:

1. Increasing the rate of flow increases the amount of Oxygen carried to the surface of the metal.
2. Increasing velocity reduces the thickness of the liquid film at the metal surface and affects the type of corrosion products.
3. The rate of flow has been found sufficient in certain cases to cause actual mechanical erosion of metals particularly when the media carry large amounts of gritty or abrasive suspended materials.
4. High rates of flow tend to prevent the formation of concentration cells at the surface of the metal while low rates are favorable for their formation.

The turbulent flow of media through tubes is often closely related to relatively high velocity. Turbulence is often responsible for the formation of local cells at the tube surface which cause an intense local pitting. Turbulence of the circulating medium is also often responsible for the combined erosion-corrosion of tube surfaces. This form of corrosion is much greater when the water carries mechanically entrained air. Bengough and May in the Seventh Report of the Corrosion Research Committee of the Institute of Metals, J. Inst. Metals, 32, 1924, pg. 213 in their study of effect of velocity on the corrosion of condenser tubes concluded that very turbulent flow and medium sized bubbles appear to be most active in this respect. Generally speaking, an increase in the velocity of media through or around tubes produces a corresponding increase in the rate of corrosion. In a 6% by weight air saturated sulphuric acid solution, the corrosion rate of Copper is doubled where the velocity is increased from a still solution to 4.3 ft. per second. Similar tests in 6% (by weight) air saturated hydrochloric acid Solution show a ten-fold increase in the corrosion rate of copper. Some information may be gained regarding the variation in velocity of the circulating water through the tubes of steam condensers from the following data published in Progress Report No. 6 of the A.S.M.E. Special Research Committee on Condenser tubes:

1. From 2.6 to 9.4 feet/sec. for salt water installations, with an average value of 5.9 feet/sec.
2. From 2.5 to 9.9 feet/sec. in fresh water installations, with an average value of 5.6 feet/sec.

c. Hydrogen Ion Concentration

The acid properties of solutions are due entirely to hydrogen ions, the alkaline properties to the hydroxide ions. Strong acids are those which are highly dissociated in solution and give a large number of hydrogen ions; weak acids, on the other hand, are those which are but slightly dissociated in solution and give relatively few hydrogen ions. A knowledge of the hydrogen ion concentration of solutions is of more importance in corrosion problems in most instances than that of the total acidity. The method of expressing hydrogen ion concentration most generally in use is by means of the term "pH". The pH value is the logarithm of the reciprocal of the Hydrogen ion concentration. Expressed by an equation it is written thus: $pH = \log \frac{1}{(H\not)}$

The neutral point on the pH scale has a value of 7.0. Values below 7.0 such as 6.0, 5.0, etc., denote acidity, the degree of acidity increasing as the numbers decrease. A solution having a pH value of 6.0 contains 10 times as many hydrogen ions as one having a pH value of 7.0 and a solution of pH 5.0 contains 100 times as many H ions as one of pH 7.0. Values above 7.0 such as 8.0, 9.0, etc., denote alkalinity, the degree of alkalinity increasing as the numbers increase. This explanation can be easily understood from the following tabulation of pH values:

Acid
etc. 4.0.4.5.5.0.5.5.6.0.6.5
Neutral
7.0
Alkaline
7.5.8.0.8.5.9.0.9.5.10.0 etc.

Solutions which are acid in character are usually more corrosive towards metals than solutions which are neutral and the neutral solutions are more corrosive than alkaline solutions. In the presence of oxygen or of oxidizing materials, corrosion in acid solutions may be greatly accelerated.

The pH value in itself is no measure of the corrosiveness of a solution. Two solutions of the same pH value may differ widely in their action on metals, depending both on the actual compounds influencing the pH value and on the presence or absence of other salts, gases, etc., in the solution. As an example, a solution containing 0.05 moles of ammonium hydroxide per liter and a solution containing 0.001 moles of sodium hydroxide per liter would have approximately the same pH value (11.00) but corrosion of non-ferrous alloys would be more severe in the ammonium hydroxide solution. Furthermore, the presence of an active oxidizing agent in the ammonium hydroxide solution would further accelerate corrosion at the same pH value. While no definite prediction can be made of the behavior of metals in solutions of a stated pH value, this measure of the degree of acidity or alkalinity is of value, when considered with other factors and service conditions in a correct interpretation of corrosion problems.

Other conditions affecting heat exchanger tubes will be discussed in the next issue of "Tube News".

Limitation order L-154 issued by the OPM. This order limits the use of non-ferrous condenser tubes in land power stations to Muntz metal for fresh water plants, and Admiralty metal for salt water plants. No non-ferrous metals containing more copper and more tin than these two are permitted by the order.

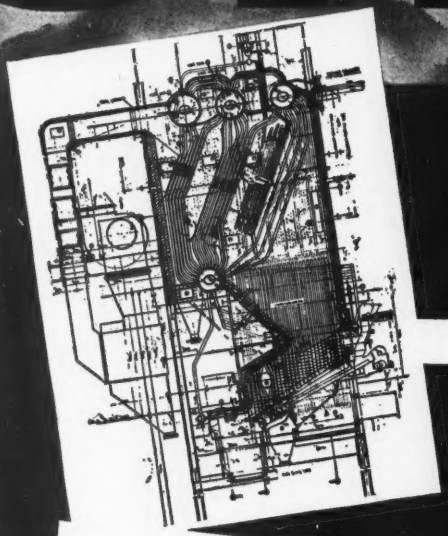
Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

STEAM *for*



POWER

SOUTHERN COLORADO POWER COMPANY
Pueblo, Colo.

90,000 lbs. steam per hour Vogt LE type bent tube boiler with underfeed stoker. Water walls and economizer. Design pressure 525 lbs. Total steam temperature 750 degrees F.

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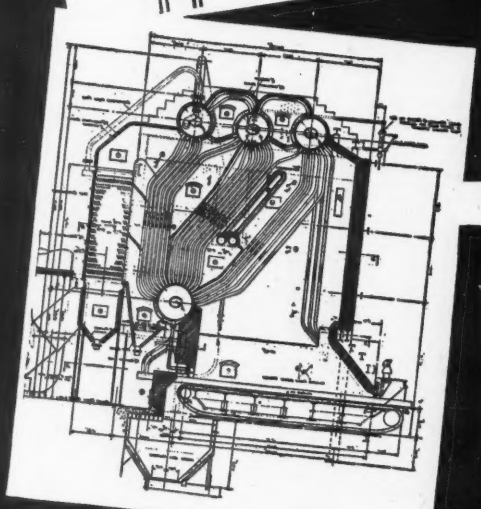

PROCESS

IN A LARGE MID-WESTERN STEEL MILL

Two 105,000 lbs. steam per hour Vogt LE type bent tube boilers with chain grate stokers and economizers. Design pressure 225 lbs. Total steam temperature 550 degrees F.

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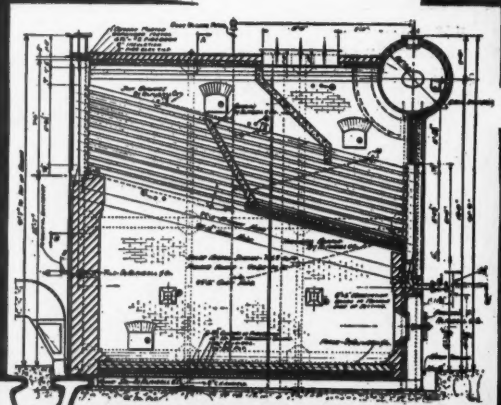


HEATING

CRIMINAL COURTS BUILDING AND JAIL
New York City

Four Vogt sectional header type boilers of 47,000 lbs. steam per hour capacity, oil fired. Design pressure 200 lbs.

HENRY VOGT MACHINE CO.
LOUISVILLE, KENTUCKY
Branch Offices: NEW YORK CLEVELAND CHICAGO PHILADELPHIA DALLAS

Vogt *Water Tube* BOILERS

BENT TUBE AND SECTIONAL HEADER TYPES

Safer Boiler Operation
Easier Maintenance with

SPECIFY! ERNST FITTINGS

Fig. 4
Standard Type—Offset Adjustable Inclined Gage Fittings

Fig. 9
Wire Glass Better-C Guards, All Sizes

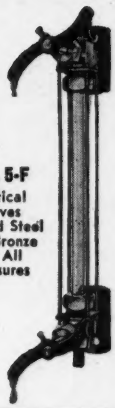


Fig. 5-F
Vertical Valves Forged Steel and Bronze for All Pressures

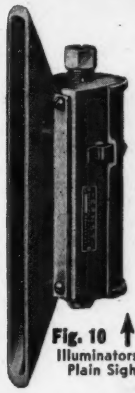


Fig. 10
Illuminators—Plain Sight

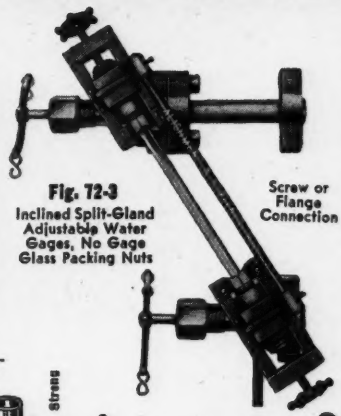


Fig. 72-3
Inclined Split-Gland Adjustable Water Gages, No Gage Glass Packing Nuts

Screw or Flange Connection

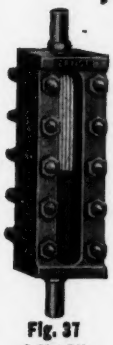


Fig. 37
C-BLACK Prismatic Flat Glass Inserts

Fig. 45
"C-Clear Thru" Flat Glass Inserts

Fig. 18 Fig. 19
FLAT GLASSES

GAGE GLASS GASKETS

Standard Pattern Gaskets
High Pressure
Fig. 22

Non-hardening and Non-softening SERIES 750

Send for Gasket Tag showing sizes

GASKETS THAT WILL FIT EXACTLY

Red Lip-mold Pattern
Fig. 21

Expansion Type Gasket

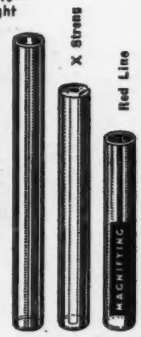


Fig. 12 Fig. 23 Fig. 14

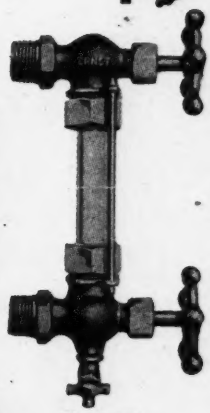


Fig. L-150
Steam Metal Bronze Gage for pressures up to 150 pounds

LEAKLESS COCKS

Bronze or Forged Steel
Fig. 13
For All Pressures

Fig. 15

For Pressures Up to 250 lb. — This Ernst DCP (Double Chain Pull) Try Cock insures a tight shut off. Order in sets of 3 to complete one water column.

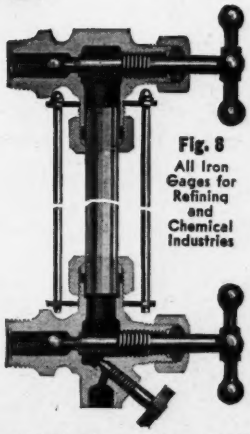


Fig. 8
All Iron Gages for Refining and Chemical Industries

Fig. 16

SIGHT GLASSES for all types OIL CUPS and LUBRICATORS

Fig. 17

SIGHT FLOW INDICATORS for insertion into Pipe lines —All Sizes—

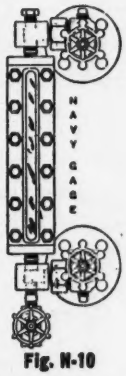


Fig. N-10

We also manufacture..

SAFETY ALARM WATER COLUMNS

FOR ALL TYPES OF BOILERS COMPLETE WITH TRIM

DELIVERIES FROM STOCK
ORDER BY FIG. NUMBERS

SEND FOR COMPLETE CATALOG and State Your Requirements

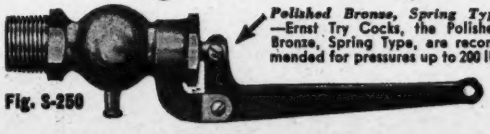


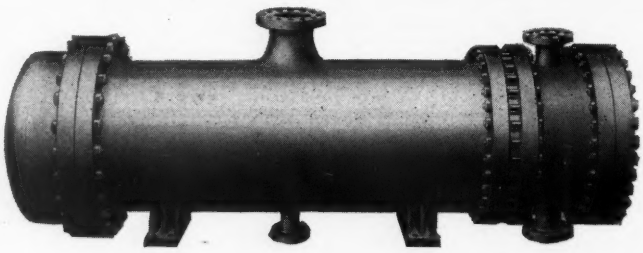
Fig. S-250

Polished Bronze, Spring Type—Ernst Try Cocks, the Polished Bronze, Spring Type, are recommended for pressures up to 200 lb.

ERNST WATER COLUMN & GAGE CO.
LIVINGSTON, N. J. Manufacturing For More Than 35 Years Phone: Livingston 6-0276

FEED WATER HEATER EQUIPMENT

for High, Intermediate, or Low Pressure Service



Lummus-designed and Lummus-built boiler feed water heaters are operating at pressures as high as 1200 pounds per square inch. Numerous Lummus units are in service in the intermediate and low pressure fields.

Lummus heat exchangers are available in all pressure ranges employed in modern power plants. Lummus heat exchanger equipment also includes Surface Condensers, Steam Jet Air Pumps, Fuel Oil Heaters, Lubrication Oil Coolers.

Lummus engineering personnel and construction facilities are available to public utilities and industrial power plants requiring equipment to meet specific conditions. Write for further information.

THE LUMMUS COMPANY
420 Lexington Ave., NewYork, N.Y.

LUMMUS

TO ELECTRICAL MEN EVERYWHERE

You Can Save Even More Copper than We Can

IN many respects, copper is more valuable than gold. For without it, we, as manufacturers, cannot produce the machines that keep plants humming; without vast amounts of it we cannot produce the electric equipment needed in such large volume by the Army and Navy.

In every G-E plant—in every G-E design office—we are spending thousands of man-hours to the end that not one pound of the "electrical" metal shall be wasted. Our engineers in the field have a similar objective—to help you save copper in the *application* of electric equipment.

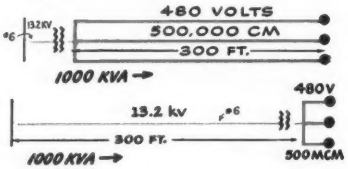
For many months we have been making available to everyone the more significant, the most useful facts pertaining to copper conservation. Witness the several publications shown here, and described further in the following pages.

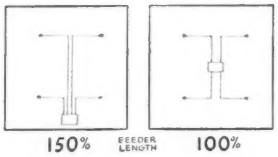
From all these facts, one conclusion stands out clearly. You men in the field—collectively—by making proper application of cable, transformers, motors, control, and other devices, can save even more copper than we can. You can save more in days than a manufacturer can save in months, just by making the right applications. We urge you to study the facts and lend your best judgment to the highly important job of conserving this most precious metal. ***General Electric, Schenectady, N. Y.***

The Army-Navy "E", for Excellence in the manufacture of war equipment, now flies over six G-E plants employing 100,000 men and women.

GENERAL ELECTRIC

FOR NEW PLANTS OR PLANT EXTENSIONS, REMEMBER THESE SIMPLE COPPER-SAVING RULES





To carry 150 kva — 3 phase —

At 208 volts, requires this size copper conductor

At 240 volts, requires this size copper conductor

At 480 volts, requires this size copper conductor

A detailed explanation of these principles is available in our recent publication, "5 Ways to Conserve Copper." Ask for GED-1011.

1. Cover as much distance as possible with high-voltage circuits. Keep the low-voltage (heavy copper) circuits as short as possible.

2. Locate substations in the centers of load areas. Modern safety-enclosed unit substations make this practicable.

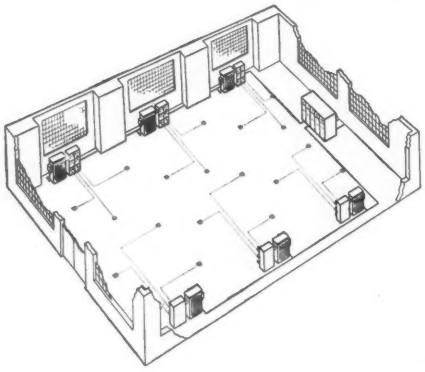
3. Use small-size substations. You save copper that way; but they must not be too small or your use of materials won't be economical. The optimum substation ratings for 480-volt secondaries are 750 and 1000 kva; and for 208/120-volt or 240-volt secondaries, 300 and 500 kva.

4. Distribute power at the highest practical voltage. For example, choose 440 volts for your integral-horsepower-motor circuits in place of 220 volts.

5. Use cable with high-temperature insulation to carry more current—varnished cambric instead of code rubber.

IF YOU SUBSCRIBE TO THESE PRINCIPLES YOU'LL WANT A COPY OF THIS BOOKLET...

GED-1006



One of the important developments in electric power systems since the war began is the load-center method of distributing power in industrial plants. This is based on the use of compact, factory-assembled, load-center unit substations, as shown in the illustration at the left.

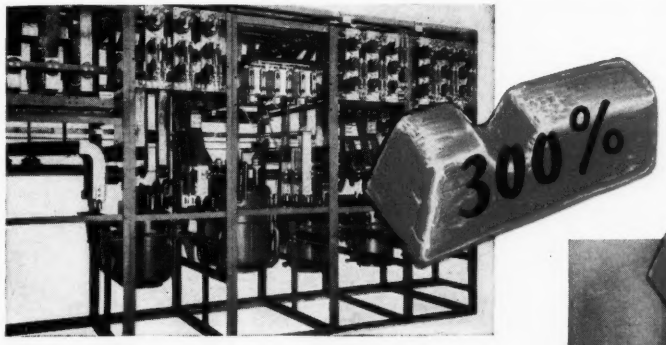
Power is distributed at relatively high voltage (2.4 to 13.2 kv) within the plant to load-center unit substations located near the centers of electrical load areas. There it is stepped down to utilization voltage (below 600 volts) and distributed to the load through drawout air circuit breakers and *short* secondary feeders. By keeping the heavy secondary feeders to the minimum length, considerably less copper is required, and the performance of motors, lamps, etc., is materially improved by the resultant reduction in voltage drop.

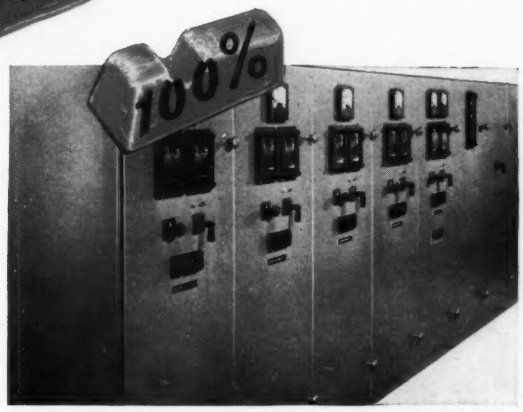
GENERAL ELECTRIC

THE RIGHT KIND OF SWITCHGEAR, TOO MEANS COPPER SAVED

—AT LEAST 60%, ON MOST JOBS

Write for Bulletin GES-3031, on how to save copper through properly applied switchgear.



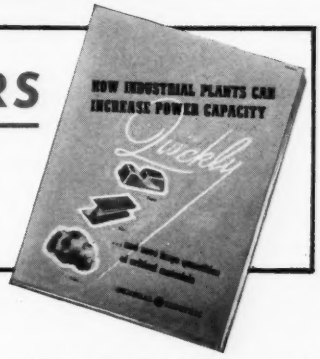


Open-type switchgear—with many strung-out copper interconnections mounted on a bulky, structural-steel framework—calls for a lavish use of copper.

Safety-enclosed switchgear is compact, and its copper interconnections are short. What's more, it completely eliminates the copper disconnecting switches seen in the open-type assembly (above), because modern vertical-lift breakers can be quickly and easily connected and disconnected from the main buses. These and other savings regularly cut switchgear copper requirements to less than *one third*.

CAPACITORS ARE GREAT COPPER SAVERS

They provide increased power capacity without adding new generators, transformers, or feeders.



1 INSTALLATION OF FOUR NEW CIRCUITS

	Critical Materials Required (pounds)			
	Copper	Steel	Others	Total
3 New 250-kva single-phase transformers	1525	8100	---	9625
4 New feeder circuit breakers	562	1800	512	2874
Cable for 4 new feeders	4940	---	1230	6170
	7027	9900	1742	18669

2 INSTALLATION OF CAPACITORS

	Critical Materials Required (pounds)			
	Copper	Steel	Others	Total
15 capacitors—90 kva each (One capacitor installed at each load center)	360	2370	2145	4875
SAVINGS IN CRITICAL MATERIALS	6667	7530	-403	13794

Consider a typical industrial plant 400 ft by 750 ft, which has a peak load of 3000 kva, served by 15 circuits, each carrying 200 kva. Because of a large amount of inductive equipment (motors, welders, etc.), the power factor of the circuit is only 75 per cent.

To meet demands for increased production, 718 kva of new power-system capacity must be supplied. You can install four new circuits of 200 kva each. Or you can install capacitors on each of the present circuits. The tables at the left compare the two methods. See how 13,794 pounds of critical materials (6667 lb copper) can be conserved. Incidentally, the capacitor method costs about half as much as the installation of new circuits.

How Industrial Plants Can Increase Power Capacity Quickly—and save large quantities of critical materials—is the subject of a new booklet (GES-3039) now available through your local G-E office.

GENERAL ELECTRIC

YOU MAY BE ABLE TO SAVE 25% IN *CRITICAL MATERIALS* BY MODIFYING YOUR PEACETIME MOTOR POLICY

The new G-E MOTOR FITNESS MANUAL tells what to do to get the most out of motors, old and new. If you are undertaking new work on motor-equipped machines, if you are "switching" motors from one job to another, or equipping machines with new motors, you'll find this bookful of helpful motor facts will save you valuable time. Included with it is another new publication—"How to Save Critical War Materials." This contains the latest WPB recommendations for the selection of motors, and other useful data. Write today for your "MOTOR FITNESS MANUAL, GED-1017."

MOTORS NEEDLESSLY LARGE FOR THE JOB—plus the oversize distribution circuits they require—may be 25 per cent or more on the side of the enemy! That's the percentage of copper and other scarce materials frequently wasted by overcautious motor specifications—by buying the "next larger size" than a machine actually needs.

The extra amount of critical material used in the oversize motor itself is only part of the loss. Operating a motor continuously below its rated capacity can mean wasted copper all the way back to the power plant. Therefore, even your present motors should be so applied as to avoid "overmotoring," wherever possible.

Why not check with your engineers to see if your peacetime motor policy can be modified in the cause of conservation? You'll be helping to make more metals available where they're needed most to win the war.

This new load calculator—the G-E MOTORULE—makes it easy to select motors that match the job when the recommendations of the machine builder are not available. It helps avoid the risk of undermotoring and the waste of overmotoring. With this motorule, you can check to make sure you are getting the most out of all your machine motors, old or new.

Accurate—easy to understand—applicable to the working of a wide range of materials. FREE with full instructions from your G-E Motor Representative or direct from General Electric, Schenectady, N. Y.

FIND METAL-CUTTING HORSEPOWER *QUICKLY* WITH THE G-E MOTORULE

NEW DEVELOPMENTS IN FLUORESCENT LIGHTING SAVE BOTH *COPPER AND STEEL*

The new G-E Forlamp (265-volt) ballast for war-plant fluorescent lighting operates four 100-watt lamps—twice as many as any ballast previously available. And it's the same size as the Tulamp 100-watt (118-volt) ballast.

This means a saving of 50 per cent in critical materials in plants where voltages within the 250–280 range are available. Furthermore, large savings of copper can be made in the lighting circuit, too, since this ballast operates on circuits of 277/480Y volts. Single-phase circuits of 277 volts require from 60 to 70 per cent less copper than those of 120 volts. Ask for publication GES-3033.

GENERAL ELECTRIC

It's no woman's work—

—and MEN are scarce!

THE gals (bless 'em) are doing a noble job in war industry, but it's hard to picture one sturdy enough to handle the business end of a tube cleaner. It's also difficult to picture many men equal to the job that are not in the army or needed for something more necessary.

Yes, "something more necessary" is right! For most of this cleaning business can be avoided by proper boiler water conditioning. That's where Elgin Water Conditioning comes into the picture. There are three ways we can serve you right now:

1. WATER CONDITIONING EQUIPMENT

Elgin Water Conditioning Equipment is available promptly for essential wartime needs. Major products are:

- ▶ Zeolite Water Softeners
- ▶ Boiler Water Conditioning Systems
- ▶ Deconcentrators (for removing sludge, mud and suspended matter from boilers)
- ▶ Continuous Blowdown Heat Exchangers
- ▶ Water Filters and Purifiers

2. WATER TREATING CHEMICALS

Elgin Water Treating Chemicals are promptly available for any need. Treatments are individually prescribed after complete analysis of water samples and engineering surveys—solve the problem for many plants, particularly those where mechanical equipment is restricted. They include:

- ▶ Boiler Water Treatments
- ▶ Process Water Treatments
- ▶ Hot Water Treatments
- ▶ General Cold Water Treatments
  (No charge for water analysis and consultation)

3. ZEOLITE FOR RECONDITIONING SOFTENERS

Elgin Zeolite re-fills are immediately available. Shipment from stocks can be made on:

- ▶ Standard Greensand Zeolite
- ▶ High Capacity Greensand Zeolite (approximately double the capacity of ordinary greensand)
- ▶ High Capacity Synthetic Zeolite (approximately four times the capacity of ordinary greensand)

ELGIN SOFTENER CORP., 136 N. Grove Ave., Elgin, Illinois

Elgin takes over the whole responsibility

● The Elgin line is all-inclusive; so Elgin recommendations are necessarily *unprejudiced*. Our district engineer will call and arrange for water analyses and plant survey—made without charge or obligation. Recommendations are accompanied by complete engineering data such as drawings and facts about results to be obtained. Whether equipment or treatment is used, operation is supervised and checked by us to assure most efficient results. The success of Elgin Water Conditioning is a direct result of not only solving problems but keeping them solved!

Engineering data and layouts furnished on request. Write us today.

★

ELGIN

Water Conditioning for every need

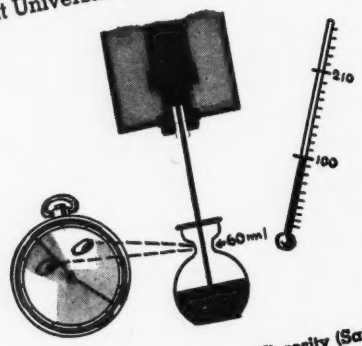
VISCO

TIDEWATER LUBRICANIA

DEFINITION: The resistance to distortion offered by a fluid, because of its cohesion or internal friction, is called Viscosity. A heavy bodied slow pouring liquid is high in viscosity.

TEST: The commercial instrument commonly used in the United States for determining viscosity of mineral lubricating oils is the Saybolt Universal Viscosimeter (S.U.V.). The viscosity, expressed in seconds (Saybolt Universal), is the time required for 60 milliliters of the liquid to flow through the standard aperture of the instrument at a stated temperature.

The Saybolt "Furol" Viscosimeter is often used in connection with very heavy oils. Multiply Furol seconds by 10 to obtain approximate Saybolt Universal seconds.



Examples	Viscosity (Saybolt Universal) at 100°F	at 210°F
Kerosene	32 sec.	40-50 sec.
Light Machine Oils	150-250 sec.	150-250 sec.
Steam Cylinder Oils	2000-6000 sec.	

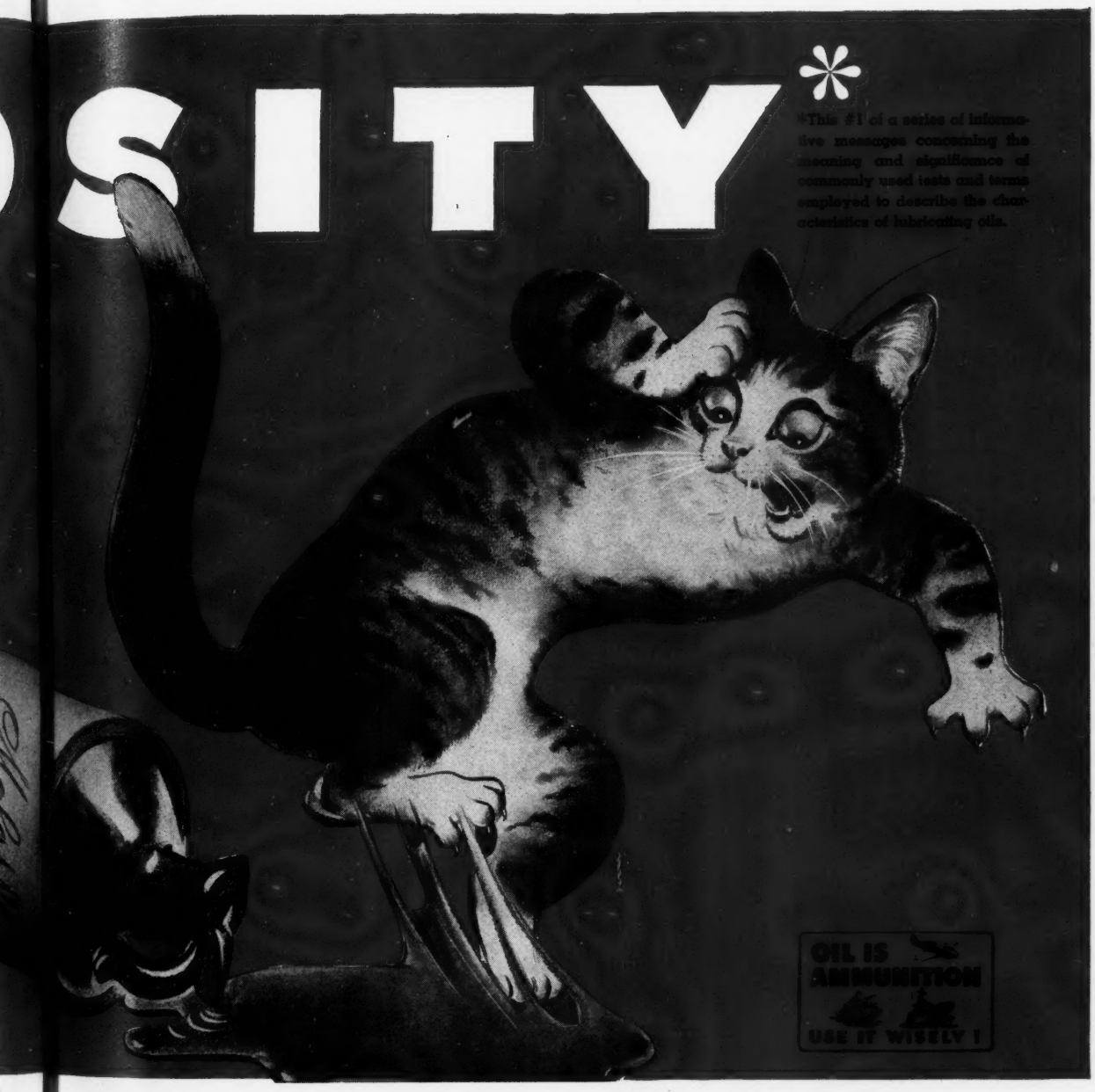
DRUMS! DRUMS! DRUMS!
War needs make it extremely important that all empty drums be returned immediately.

TYCOL

S.CIENTIFICALLY

OSITY*

*This #1 of a series of informative messages concerning the meaning and significance of commonly used tests and terms employed to describe the characteristics of lubricating oils.



Tycol lubricants are manufactured to definite, predetermined viscosities. Each Tycol lubricant when used for the recommended purpose provides correct viscosity at the operating temperature. This accomplishes complete separation of the rubbing surfaces by a film of oil for their protection, yet without needless drag from excessive fluid friction. This is but one of many tests that assure unvarying high quality in Tycol lubricants.

TIDE WATER ASSOCIATED OIL COMPANY

Eastern Division: 17 Battery Place, New York • *Principal Branch Offices:* Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

MAKERS OF THE FAMOUS VEEDOL MOTOR OIL

INDUSTRIAL LUBRICANTS

ENGINEERED FOR EVERY INDUSTRIAL USE

IF IT'S PIPING
CONTACT FLORI
OUR scope: Fabricated Piping...for steam, water, air, oil, gas, chemicals
Random mill or cut lengths, bent, coiled, welded, flanged, threaded. Valves, Pipe Fittings.
In brief: anything in tubular or plate steel fabrication.
Our customers: United States of America and Allied Nations.
Send us your inquiries.
FLORI
PIPING
THE FLORI PIPE COMPANY • ST. LOUIS, MO.

How to Get More Life From Worn-out Boilers

If they can pass inspection and a hydrostatic test, APEXIOR will "peg" that condition for more years of good performance.

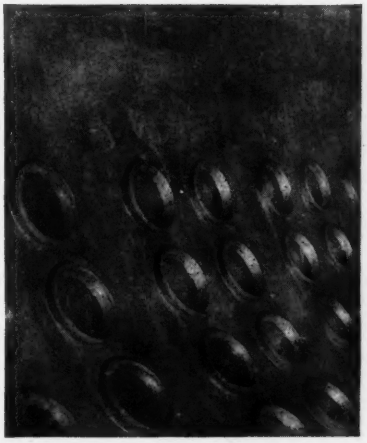
Those boilers nearing the end of their life . . . those boilers already on the inactive list — there's an excellent chance you can get more years of work out of them by APEXIORIZING.

Any boiler that can withstand the required hydrostatic pressure is good for plenty of hard service — if the test strength of the metal is maintained by a durable coating of APEXIOR.

APEXIOR PREVENTS CORROSION FOR 2-3 YEARS

APEXIOR is brush-applied, by hand or power-coater. It fills in the metal pores and joints and forms an impenetrable barrier against water. There is less adherent scale, so scale removal is made easy (with a wire brush) . . . and less often required.

Hundreds of operators have used



APEXIOR for years as an economical means of boiler maintenance. Hundreds more have recently adopted APEXIOR as a guarantee of longer life for metal that cannot be replaced.

An APEXIOR coating will last 2 or 3 years, often longer. It is easily renewed. Save *your* boiler metal from wear and damage that cannot be measured in dollars. APEXIORIZE — and keep boiler metal young.

Easy to Apply — Easy to Maintain — Bulletin 1290 Gives Facts on a Paint that Gives Metal New Life.

ENGINEERING SALES REPRESENTATIVES

Pittsburgh, Cincinnati, New Orleans, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, Dallas, Houston, Vancouver, B. C., Montreal, P. Q., Havana, Cuba, Honolulu, T. H., Marine Dept., 114 Liberty St., New York, N. Y.

Users like these have applied APEXIOR for years. APEXIOR will help YOU get more service from irreplaceable equipment.

U. S. Coast Guard
Westinghouse Elec. & Mfg. Co.
Illinois Central Railroad Co.
Standard Oil Co. of N. J.
Bethlehem Steel Co.
Boston Edison Co.
Brooklyn Edison Co.
Carnegie-Illinois Steel Co.
Pacific Gas & Electric Co.
U. S. Navy Department
U. S. War Department
Sun Shipbuilding & Dry Dock Co.

A PEACETIME PLUS · · · A WARTIME MUST

APEXIOR

RECOMMENDED BY ALL U. S. AND CANADIAN BOILER INSURANCE COMPANIES

The **DAMPNEY COMPANY**
of America
protective coatings for
STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

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HOW TO GET MORE SERVICE FROM PUMP RODS AND SHAFTS...

PART 2–

Re-conditioning by building up and finishing

Putting worn pump rods, shafts and wearing sleeves back into shape usually may be done by machining and refinishing, as described in Part 1 of this series last month.

However, if too much metal must be removed to clean up the worn section, the shaft may be unduly weakened.

If a shaft shows a tendency to "whip"...or if a reciprocating pump rod tends to "bow" on pressure strokes, the pump manufacturer should be consulted. He may advise building up the shaft before machining.

If so, a choice may be made from three methods: *welding, metal spraying, or electroplating.*

Space does not permit a complete description of these operations, but the advantages of each method are given below.

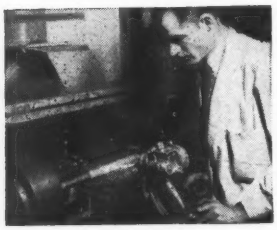
Rods and shafts of Monel or "K" Monel can be built up for re-finishing by the methods given here. The excellent mechanical properties of the Monels provide an extra margin of strength, rigidity and toughness beyond the ordinary demands of normal work.

A bulletin, "New Parts from Old," that includes complete information on the above operations, together with the method of reconditioning by machining and refinishing described previously, will be sent on request.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street **New York, N. Y.**

ADVANTAGES OF WELDING

This method produces a stronger, tougher, more rigid shaft or rod than does spray coating or electroplating... and the mechanical properties of the rebuilt-by-welding shaft closely approach the mechanical properties of the original. Electric arc welding is preferred and the equipment required will be found in almost any maintenance shop.

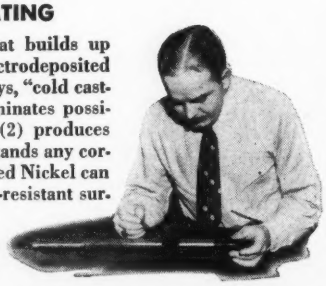


ADVANTAGES OF SPRAY COATING

This is the simplest method of the three. For some purposes, the peculiar, porous structure of sprayed metal coatings is a drawback; it adds little tensile strength or toughness. However, in many shaft applications, this porosity is considered a virtue...the pores fill with lubricant in service which is believed to account for the increased working life of the part.

ADVANTAGES OF ELECTROPLATING

Another method is "cold casting" that builds up worn parts with heavy coatings of electrodeposited nickel. Although slower than other ways, "cold casting" offers these advantages: (1) eliminates possibility of heat distortion and warpage. (2) produces a dense fine-grained deposit that withstands any corrosive condition under which solid rolled Nickel can be used. (3) makes an extremely wear-resistant surface, as the hardness of the plating can be controlled to develop tempers ranging up to several times the hardness of the original pump rod or shaft.



SUGGESTIONS FOR OPERATING PUMPS TO PROLONG LIFE OF RODS AND SHAFTS

Use a good quality of packing recommended by a good packing manufacturer for the particular type of service.

•

Before putting in new packing, make sure that every particle of the old packing is cleaned out.

•

Tighten up the packing gland evenly, back off the nuts two or three turns, and adjust them finger tight.*

•

Make sure that the gland followers do not ride on the piston rods or impeller shaft.

•

To prevent burning of the packing and scoring of the shaft or sleeves in a centrifugal pump, a small amount of water should always seep out through the stuffing box while the pump is running.

•

Two ways to make packing last longer in centrifugal pumps are to use a light grease on the new packing and to cool the stuffing box externally until the packing is "run in" and some sealing water leaks through the box.

•

When packing becomes hard and dry, do not attempt to stop excessive leakage by tightening up further on the gland. Replace packing immediately.

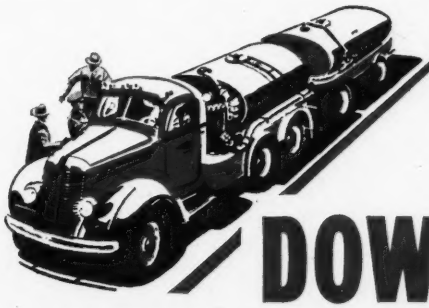
•

*Finger-tight is tight enough as long as the shaft or rod remains smooth and perfectly cylindrical. Shafts and rods of Monel or "K" Monel—with their qualities of high resistance to both corrosion and wear—tend to stay smooth and perfectly cylindrical longer.

★ ★ ★ ★ ★ **INCO NICKEL ALLOYS** ★ ★ ★ ★ ★

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL

Sheet... Strip... Rod... Tubing... Wire... Castings



DOWELL

INDUSTRIAL CLEANING AND SCALE REMOVAL SERVICE

More power for production—less down-time—safety and longer life for present equipment—these are the advantages chemistry offers in cleaning heat exchange surfaces.

Dowell Industrial Cleaning Service makes use of chemical solutions for the disintegration and removal of deposits which coat heat exchange surfaces. *This is not a feed-water treatment.*

The "know how" for this service comes from more than eleven years of experience in handling large volumes of chemicals, which are used by the Petroleum Industry to increase production from oil and gas wells.

In industrial cleaning work specially designed trucks are used for transporting and handling the chemicals. Pumps circulate chemical solutions to all points where steam or water flow. Costly time-consuming dismantling of equipment is unnecessary.

For information write Dowell's Tulsa office.

DOWELL INCORPORATED

Executive Office: Midland, Michigan
General Offices: Kennedy Bldg., Tulsa, Oklahoma
Subsidiary of The Dow Chemical Company

J-M Moulded Packing Cups are made to take the toughest kind of service on all types of slow-moving pistons and rams operating against air, water, steam, oil, etc. Even against extremely high pressures and temperatures they stand up in service and assure a positive seal with minimum friction.

J-M Moulded Cups are "custom-made" . . . moulded to the exact shape and size required. Their composition can be varied to meet specific service conditions. For details on Moulded Packing Cups and on the complete line of J-M Packings, ask for the J-M Packing Catalog. Johns-Manville, 22 East 40th Street, New York, N. Y.

JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

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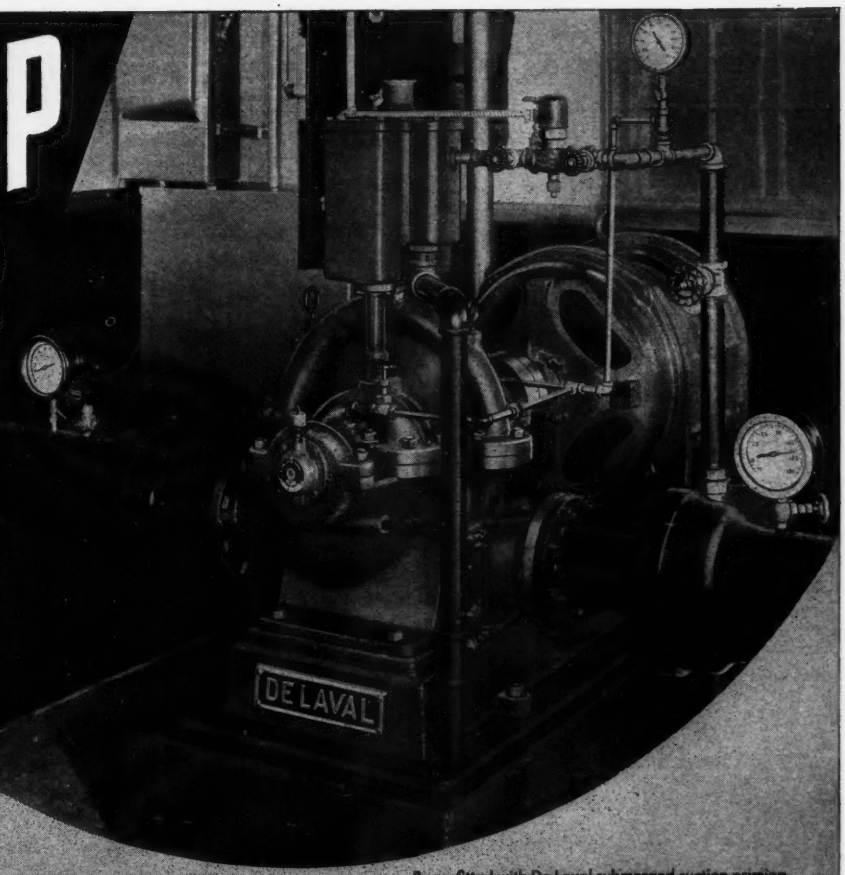
PUMP *comes* RIGHT *back!*



Pump fitted with De Laval submerged suction priming system, 1100 g. p. m. against 245 ft. at 1750 r. p. m.

If the three-quarter-inch corporation cock on the suction pipe of the pump illustrated above is opened wide, delivery of water ceases, but is resumed again within one minute after the cock is closed, the pump being at once reprimed by the

DE LAVAL *SUBMERGED SUCTION* PRIMING SYSTEM

Were the air inleakage too great for the priming system to handle, the pump would automatically be shut down and could not be started again until the fault had been corrected.

With the De Laval Priming System the pump cannot be started unprimed.

Danger of surges or water-hammer reaching the pump casing is eliminated or minimized.

The pumping unit can be started or stopped at any time, from a remote control point if desired.

Proper adjustment of packing glands is simplified, as pressure is not admitted to the pump casing and suction line.

Ask for Publication P-3224.

HYDRAULIC INSTITUTE U.S.A. MEMBER

DE LAVAL *Steam Turbine Co.*
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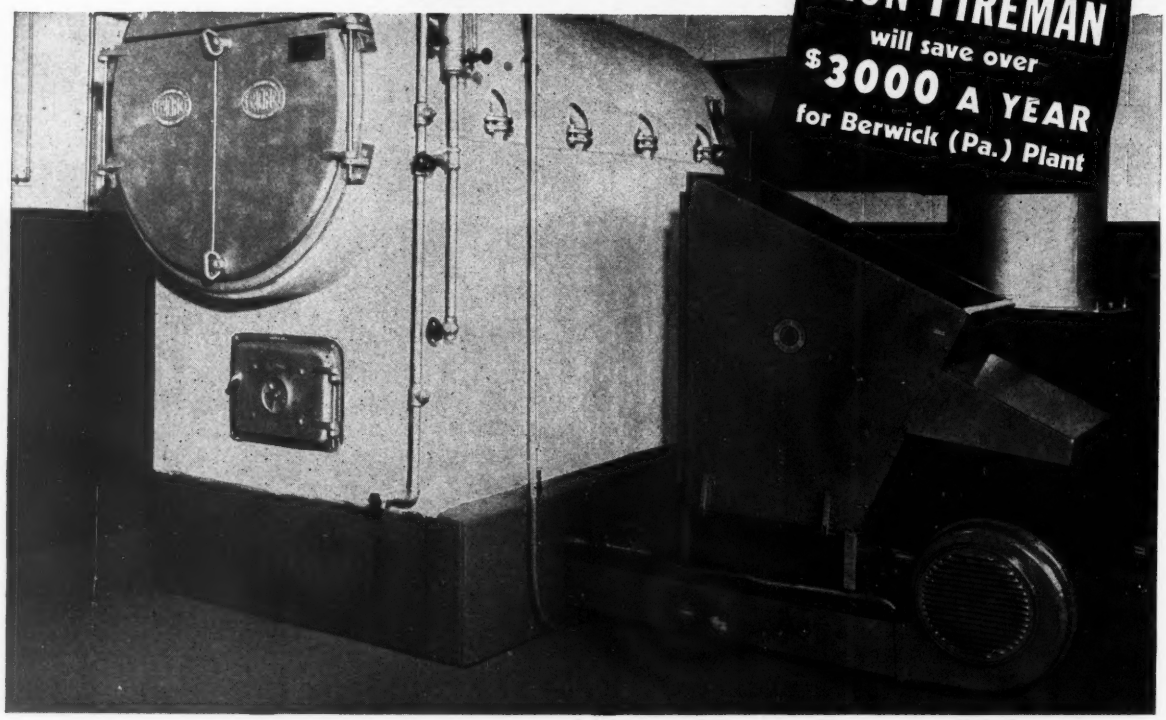
MANUFACTURERS OF TURBINES — STEAM, HYDRAULIC; PUMPS — CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, CLOGLESS, SELF-PRIMING; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS — WORM, HELICAL and FLEXIBLE COUPLINGS

Pennsylvania Plant Changes to Coal



Berwick Weaving, Inc., Switches to IRON FIREMAN Stoker Fired Coal

★ "The changeover from a restricted fuel to automatic coal reduced fuel bills at Berwick Weaving, Inc., $3,368.53 in 1942," says Charles C. Hertel, Jr., president. "Our 1942 coal bill for heating and process steam was $1090.47, whereas previous fuel bills amounted to $4459 for the same operations.

Charles C. Hertel, Jr.

"Iron Fireman firing is maintaining a *uniform* temperature—between 86° and 88° Fahrenheit and a relative humidity of between 63% and 65%, 24 hours a day, 7 days a week—necessary to the type of cloth manufactured at Berwick. Besides it provides steam 10 to 16 hours a day, 5 days a week, for a process machine which consumes 600 lbs. of steam per hour."

Iron Fireman Poweram at Berwick

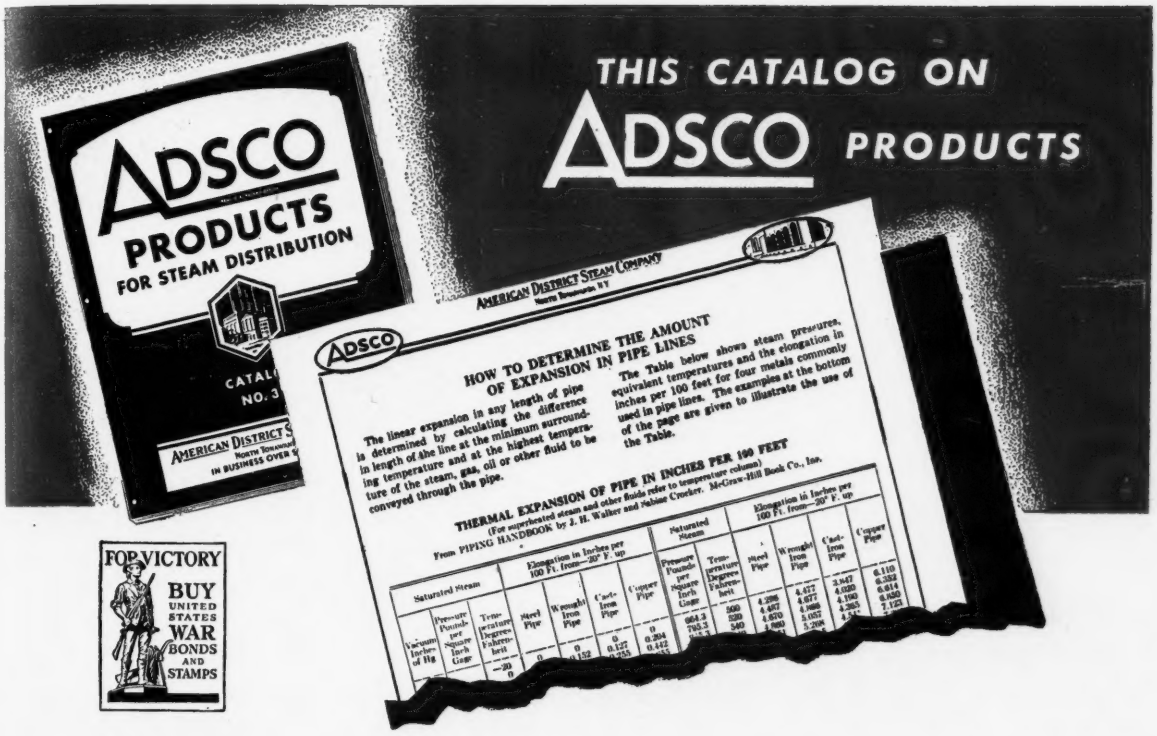
The clean-cut appearance of this Poweram installation has set a standard of cleanliness throughout the whole Berwick Weaving plant. The side installation keeps the boiler front clear. The Iron Fireman Poweram stoker, designed for heavy, continuous loads, combines *worm feed* with *ram distribution* of coal. The worm conveys the coal to the retort in a loose, aerated condition; reciprocating blocks distribute it evenly and prevent packing.

Today, in tens of thousands of boiler rooms, Iron Fireman coal stokers, burning an *unrestricted* fuel, are helping industries meet war needs by stepping up steam output 10% to 35%.

Easy to Change to Iron Fireman Coal Firing

If you are faced with fuel changes or increased steam loads, find out how quickly Iron Fireman equipment can be installed. Iron Fireman engineers are ready to make an immediate survey of your steam plant, no obligation. For free survey or complete catalog on the Iron Fireman Poweram, write or wire the Iron Fireman Manufacturing Co., 3324 W. 106th St., Cleveland, Ohio.

IRON FIREMAN AUTOMATIC COAL STOKERS


THIS CATALOG ON
ADSCO PRODUCTS
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PRODUCTS
FOR STEAM DISTRIBUTION
AMERICAN DISTRICT STEAM COMPANY
HOW TO DETERMINE THE AMOUNT OF EXPANSION IN PIPE LINES
The linear expansion in any length of pipe is determined by calculating the difference in length of the line at the minimum surrounding temperature and at the highest temperature of the steam, gas, oil or other fluid to be conveyed through the pipe.
The Table below shows steam pressures, equivalent temperatures and the elongation in inches per 100 feet for four metals commonly used in pipe lines. The examples at the bottom of the page are given to illustrate the use of the Table.
THERMAL EXPANSION OF PIPE IN INCHES PER 100 FEET

Will Help You Plan SERVICE LINES For War Projects and Plants

Follow the example of engineers, working on America's largest war projects.

Make the ADSCO Catalog No. 35 your guide for economical and efficient operation, whenever you specify or purchase expansion joints or other equipment for steam, hot water, fuel oil or gasoline lines.

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AMERICAN DISTRICT STEAM COMPANY

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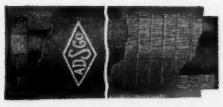
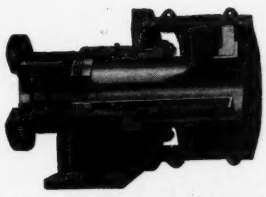


ADSCO RED DIAMOND BRAND WOOD CASING. For underground steam lines. Its wood construction saves critical metal.



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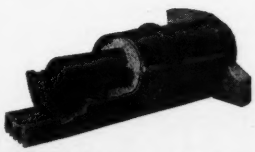
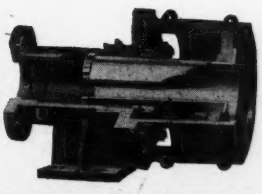
ADSCO FLOW METER ORIFICE TYPE. Accurately measures steam, water, air or gas.



ADSCO-BANNON TILE CONDUIT. A strong, vitrified conduit for underground steam and hot water lines.



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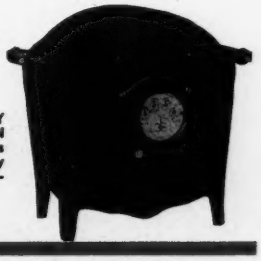

ADSCO ROTARY CONDENSATION METER. Measures steam consumption by metering the condensate.

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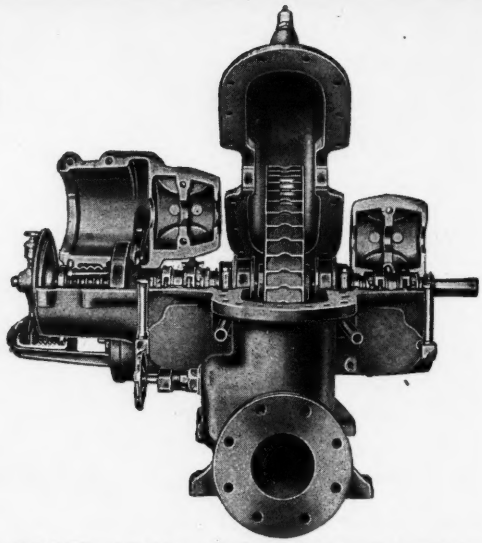
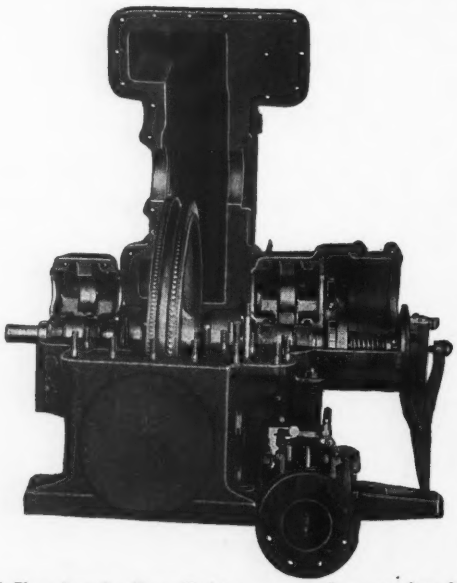
OFFERS COMPLETE COVERAGE OF MECHANICAL DRIVE TURBINES

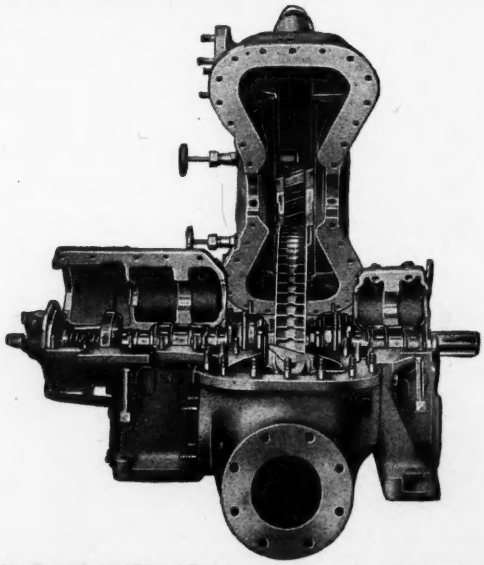
1200 Horsepower Terry Multi-stage Turbine. Units of this type are employed extensively for driving large pumps. The units may be designed for non-condensing, condensing, mixed pressure, or bleeder operation. They may be equipped with constant speed or variable speed governors, remote speed controls or with special governors to meet unusual requirements. Ask for Bulletin SR-114.



Terry Solid Wheel Turbine with Top of Casing Raised. Note the ruggedness and the ease with which the interior parts can be inspected — one of the country's leading oil companies employs 308 of these units for driving various types of refinery pumps. Full details are available in Bulletin S-116.



Axial Flow Impulse Terry Turbine — one of a complete line — built with either two or three rows of blading. These units, like all Terry turbines, are the result of over 45 years of successful experience in the manufacture of turbine drives exclusively. Completely described in Bulletin S-107.



Twelve Terry Solid Wheel Turbines, similar to the above unit, drive auxiliaries in the power house of an east coast refiner. They operate with steam at 625 lbs. pressure — 700° Total Temperature. Eight of the machines exhaust against 125 lb. back pressure. The first of these units was purchased in 1931. It proved entirely satisfactory so that as the plant was enlarged, duplicate Terry's were added. Bulletin S-99.

THE TERRY STEAM TURBINE CO.

TERRY SQUARE HARTFORD, CONN.

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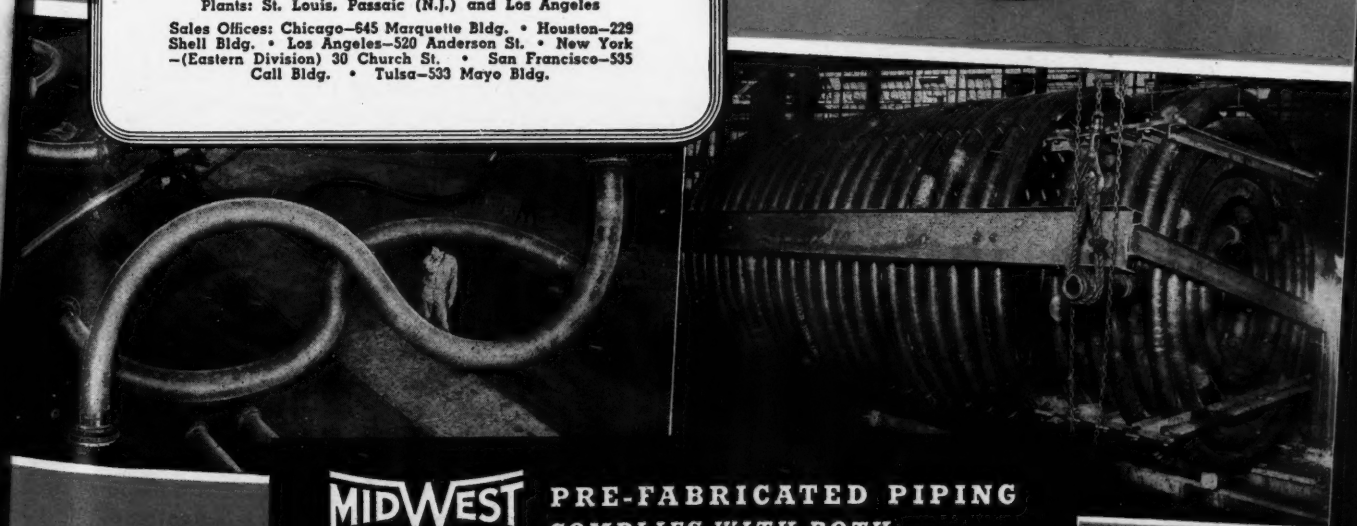

MIDWEST PRE-FABRICATED PIPING *COMPLIES WITH BOTH* ASA CODE FOR PRESSURE PIPING *and* ASME BOILER CONSTRUCTION CODE

FOR INSULATION . . .
EHRET'S
85% MAGNESIA

Be it natural or synthetic, rubber is the *one* best material for tires. Its unique physical properties and characteristics dictate its almost exclusive use on cars, trucks and tractors—both civil and military.

And likewise, in the field of thermal insulation, there is *one* material that has proved itself in service for more than half a century . . . 85% Magnesia. Its high insulation efficiency, workability, light-weight, strength, uniformity, long-life and overall economy are matters of record . . . not of hope or conjecture.

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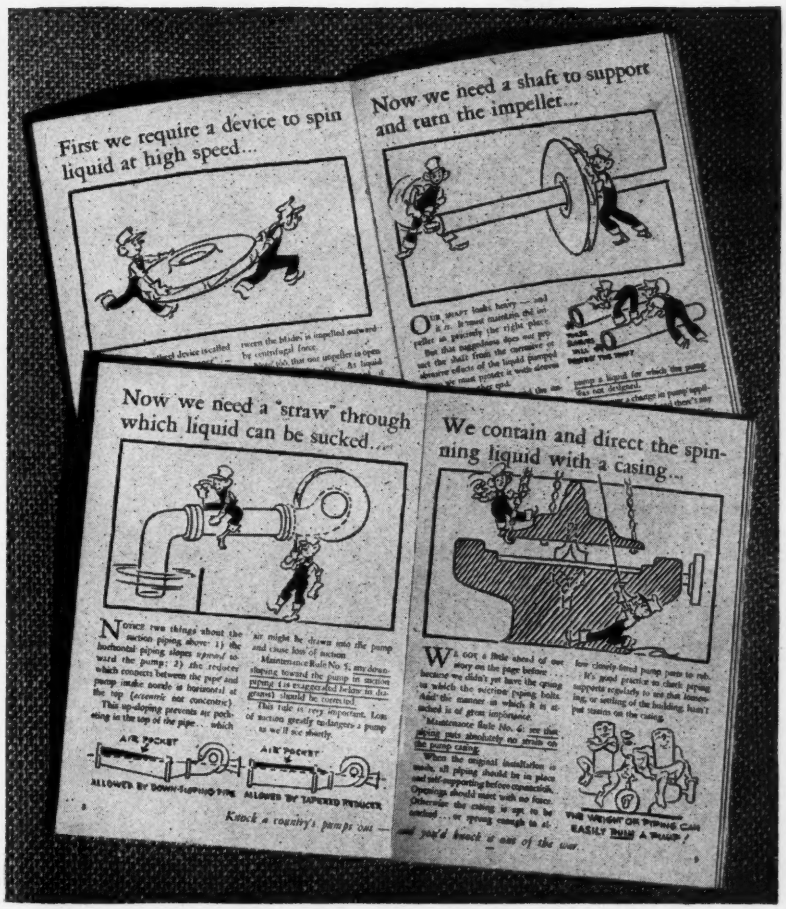
Man the Pumps!


First we require a device to spin liquid at high speed...
Now we need a shaft to support and turn the impellet...
Now we need a "straw" through which liquid can be sucked...
We contain and direct the spinning liquid with a casing...
AIR POCKET
AIR POCKET
ALLOWED BY DOWN-SLOPING PIPE
ALLOWED BY TAPERED REDUCER
Knock a country's pumps out —
and you'd knock it out of the war.
THE WEIGHT OF PIPING CAN EASILY PUSH A PUMP!

When you do need new pumps—take a good look at the extra efficiency, ruggedness and long life built into Allis-Chalmers centrifugal pumps . . . the famous "Electrifugal" — and all types of pumps for every purpose. In the meantime, let "Handbook for Wartime Care of Centrifugal Pumps" help you make present pumps *last!*—→

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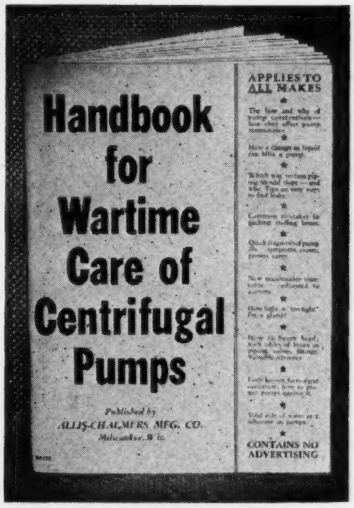
WE WORK FOR VICTORY — WE PLAN FOR PEACE

—TODAY THAT MEANS: "MAKE 'EM LAST!" . . AND HERE'S ALLIS-CHALMERS' GREAT NEW CENTRIFUGAL PUMP MAINTENANCE GUIDE TO HELP YOU DO IT!

HERE'S THE REASON most pre-war pump maintenance literature is seriously out of date today: *pumps that used to work 1800 hours a year are now working 8700 hours a year.*

Another reason: America can no longer *afford* unnecessary pump failures or lowered efficiency!



In Allis-Chalmers' new centrifugal pump maintenance book a pump is *built* . . . giving fresh, new insight into the kind of care a pump needs in *wartime.*

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128 YARWAY IMPULSE TRAPS
at St. Croix Paper Co.

WINTERS are really cold in Woodland, Maine, up on the Canadian border, but Yarway Impulse Traps handle the heavy condensate load with dispatch at the St. Croix Paper Company Plant. 128 Yarway Impulse Traps are in use at this plant — draining unit heaters, air preheaters, steam mains and other equipment.

More than 180,000 Yarways Have Been Sold . . .

. . . purchased on their performance. Users report that *quicker heating* and *greater sustained heating efficiency* soon pay for their installation and continue to return worthwhile profits in plant operating economy. Then, too, the Yarway Trap's *small size saves space.* Its *light weight simplifies installation.* Its unique design with *only one moving part,* and its *rugged bar-stock construction,* keep down maintenance expense.

Good for all pressures over wide range without change of valve or seat — it may be used on any constant or fluctuating pressures.

And when you consider that their *purchase price* is usually *no more than the cost of repairing an ordinary trap* —why not get Yarway performance for your money?

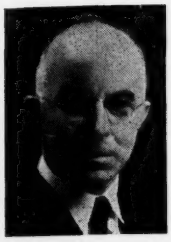
A nearby Mill Supply Dealer handles Yarway Impulse Traps and will be glad to serve you. Or write for Catalog T-1737.

YARNALL-WARING CO., 114 Mermaid Ave., Phila., Pa.

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

A Federal Department of Planning



By ROY C. MUIR

AS PART of the coordinated planning necessary to make the technological benefits available to all and to preserve peace after victory it is necessary also to have a plan within industry itself.

Federal agencies are necessary, but the underlying philosophy of these agencies must be to remove, rather than to place, obstacles in the path of technological progress.

If we are to obtain and maintain a long range plan to which we may work, we must have some of the ablest men in the country devoting their lives to this task. Perhaps we might have a fourth branch of government, a department of planning, or, if you prefer, of social and economic development.

Its members would have the standing of Justices of the Supreme Court, and its functions would be to advise the President, Congress, and the various departments and agencies of the government. With able men devoting their lives to the planning of the social and economic welfare of the nation, we might face the future with better hope and confidence.

And because technological developments, particularly in the radio and airplane, have made the world a smaller place in which to live and have brought its people closer together, we must also have some international plan of cooperation. If we are to have continuing peace throughout the world, we must have continued economic and social progress in all nations, equally, and in no nation at the expense of others.

Finally, there must be some plan within industry for winning the peace, when the war is won. We shall have lost, temporarily, at the least, many of the things we are now fighting for if we cannot keep people at work in the post-war period. The details of such plans would fill many pages, and would differ for each industry, but the principle can be summed up in one sentence: "We all want more, we all want to work, and if we all can work, we all can have more."

Millions of young men, skilled, able, will be returning from the wars, wanting work. Millions of people will want things they have been unable to buy for the duration, and they will have the money with which to buy them. There will be many new and improved products, and new and improved methods of producing them. And research will give us a continuing supply of new things with which to create new industries.

Our early presidents were right in encouraging the nation's technological development. President Cleveland was right in championing individual freedom and independence, the opportunity for the full development of the individual. President Theodore Roosevelt was right in cautioning against unwise laws which might upset the delicate balance of economic law with man-made legislation.

But there still remain many social and economic aspects of our new technology which we do not yet understand. If we better understood some of the problems of modern industry there are, no doubt, many instances in which wise legislation could contribute to their solution. Unfortunately, lacking this understanding, we have often attempted to solve these problems through legislation alone. The result has naturally often been conflict and confusion.

These conflicts must be removed, and the solution to these problems planned. And the plan must be flexible, to take into account the fact that the technological achievements of today are but a shadow of those which are to come. Already, we have pushed back the boundaries of our science and engineering under the stimulation of war, years beyond what we could have hoped to realize.

Looking into the future, we must plan for these readjustments, which, if we plan ahead, can be made without violent economic maladjustments. We must expect many changes in this world of the future; in distribution of population; in types of employment and number of people employed in various activities; in living habits. That is why we must have a continuing plan adapted to each condition which we may reasonably expect to arise.

A school of engineering should not only keep abreast of technological advances in its teaching but should also give a broad training in the science of life.

For the engineer's mission in this world is to take the God-given resources of the world, and with his God-given intelligence, shape them into new creations which will serve mankind well.

In the past he has been too willing to limit himself to the technological part of the task, leaving the social and economic aspects to others. He must form those ideals early in his career and acquire that understanding of human values and human relations which in the future will enable him to share in the leadership which carries the obligation of using the fruits of technology to the social and economic benefit of the peoples of the world.

ROY C. MUIR, General Electric Co. vice-president in charge of Engineering since 1934, was born in Arcadia, Wis., in 1881. He attended high school in Arcadia and for 2 yr. after his graduation he was associated with his father in the farm machinery and livestock business.

Mr. Muir entered the University of Wisconsin in 1901 and received his B.S. in electrical engineering in 1905. After graduation he entered the G.E. student engineering course at Schenectady where he was 2 yr. on test. In his second year, Mr. Muir was made assistant to the head of Turbine Test. In 1907 he was transferred to the Turbine Engineering Department, and in the following year, to the Power and Mining Engineering Department, now the Industrial Department.

When the International General Electric Co. was organized in 1919, Mr. Muir was appointed chief commercial engineer of that company. In 1922 he was promoted to the position of assistant engineer of the Industrial Engineering Department.

In May, 1930, Mr. Muir left the Industrial Engineering Department to become general assistant to the late Charles E. Eveleth, then vice-president in charge of engineering. In 1933 Mr. Muir was appointed manager of the Engineering Department, a position he held until his promotion the following year to vice-president in charge of Engineering.

The material presented on this page is from an address Mr. Muir made at Manhattan College. He spoke at a convocation marking the 50th anniversary of the college's School of Engineering. His Excellency, the Most Rev. Francis J. Spellman, Archbishop of New York, presided.

Honorary Doctor of Engineering degrees were conferred by the Rev. Brother A. Victor, president of the college, on Mr. Muir, Lt. Comdr. Emil Hugh Praeger, U.S.N.R., head of the civil engineering department of Rensselaer Polytechnic Institute; and Frederick H. Zurmuhlen, chief engineer of the Walsh-Driscoll Corp.

At the President's Desk

SPEAKING of front lines in engineering, as we were a few pages ago, here are a number of the men who are pushing them forward, headed by the Commander-in-Chief himself, the man concerned with all the front lines, in engineering, in battle, and everywhere else. The occasion is the presentation by the President to Clinton R. Hanna, a Westinghouse research engineer, of a citation of individual production merit for his work in developing a device that immensely increased the effectiveness of American tanks. Mr. Hanna, with his hands folded, stands directly behind the President. ¶ Incidentally, the condition of the Presidential desk has for some time been a matter of deep concern to newspaper correspondents and magazine editors. The clutter in the foreground is beyond description. You will doubtless recognize the symbol of the Demopublican party and that of the Republocratic party, seen from dead astern, the famous seagoing clock and aneroid barometer assembly, and some of the other gimmicks and gadgets. There is more, however; another table in the President's office is completely covered with ship models and other gadgets similar to those shown here. ¶ Of course, if you are a Republocrat you conclude at once that these are all evidences of a cluttered and disorderly mind. On the other hand, if you are a Demopublican you conclude at once that they are evidences of the President's wide range of interest and the extent of his responsibiilities to all the factors in national life. ¶ This is the P. C., the post of command, the front of all fronts, where the many-colored threads of American life in peace and war come together and where the man at the desk tries to weave and knot them into a fabric that will hold firm through hell and high water. Salute, Mr. President!

WITH THE EDITORS

◆ **ONE OF THE FEW** . . . Among the very few commodities which have displayed little or no shortage thus far is electric power. Despite considerable apprehension during the early stages of the war and immediately following our entry in it, no serious shortages of power have developed anywhere in this country. Considering the importance of power and when practically everything else from butter to army mules has become scarce, this may seem strange; power, one might assume, would be among the first to become scarce.

The reason for this apparently anomalous behavior of power as compared to other commodities lies in the fact, as was ably pointed out by C. W. Kellogg, President of the Edison Electric Institute recently, that power plays the same role in the business of war as it does in the pursuit of peace. For a long time the truth of this principle was not fully realized by many people, engineers and laymen alike.

At the beginning of our entry into the war, many people, impressed with the huge mass of war material that had to be produced, believed that a corresponding amount of additional electric power would be required. As late as November, 1941, Leland Olds, chairman of the Federal Power Commission, in an address before a local section of the A. I. E. E., estimated that 2¾ kw-hr. of electricity would be required for each dollar of war expenditure. As Mr. Kellogg pointed out in the early stages of the war effort this seemed to be the case, but this early indication appeared at a time when civilian activities still continued unabated, thus causing the war load to be superimposed upon them. As the business of war became preponderant, however, as it is today, the net effect of the war effort upon electric power consumption grew less and less.

Mr. Kellogg presented figures to show how the use of power had varied with respect to the war expenditures. In September, 1941, for example, we had the greatest gain in the use of electric power over that of the corresponding month the year before that we have had at any time, since June, 1940. The gain that month was 1,650,000,000 kw-hr. For that same month war expenditures showed a corresponding gain of $1,200,000,000 — a ratio of 1.39 kw-hr. of industrial energy per dollar of additional war expenditure. Now, consider the month of August, 1942, when the growth of war expenditure over the previous August was $4,000,000,000. If the ratio of additional industrial energy per dollar of additional war expenditure referred to by Mr. Olds had then been effective, the growth in the use of industrial energy for the month of August, 1942, would have been 11 billion kw-hr. Actually, however, it was just 1/10 of that figure 1.10 billion.

This question of power production and the war effort is discussed in greater detail in the article on power developments in 1942 in other pages of this issue, but the point we want to emphasize here is that as far as the use of power is concerned it seems to make very little difference whether we engage in peacetime work or in war work. When the nation turns over to war work most of the usual civilian requirements cease and as far as the electric generator in the power plant is concerned it makes no difference whether a certain machine in a factory to which the generator supplies power is turning out parts for domestic refrigerators or for machine guns; the kilowatt-hours are exactly the same.

◆ **SAVING POWER** . . . This question of power as being related to the war effort brings up another point which has been discussed before in these pages but which deserves emphasis. It was referred to in passing by H. B. Gear of the Commonwealth Edison Co., at a recent meeting of The Great Lakes Power Club. This concerns the impression that many people have in regard to saving electric power by not using power. "Many," said Mr. Gear, "seem to be under the impression that they are being patriotic in saving kilowatt-hours without regard to the hours when the saving is made. However, until public notice is given that an emergency exists and the War Production Board has called upon the public to restrict its use of electricity, the restriction-minded may only be inconveniencing themselves without adding to the war effort.

◆ **NIKOLA TESLA** . . . Alone, without relatives, more or less forgotten, at the age of 86, Nikola Tesla died in bed in his hotel room in New York, during the night of January 7. Only the newspaper reporters still referred to him as the "electrical genius" but the electrical world had long forgotten him. His obituary notices in the newspapers referred to him as the "electrical genius who discovered the fundamental principle of modern radio." As a matter of fact this is not true. Poor old Tesla had very little to do with the discoveries of the fundamentals of radio, but in his early days he experimented with the production of high frequency currents and because his oscillation transformer, generally known as the Tesla coil, produced spectacular effects, he became known as a wizard. A legend developed about him which was kept alive by the imaginations of newspaper men. Tesla was always good for a story, usually on the event of his birthday, about the startling inventions he was always working on.

This is no attempt to discredit Nikola Tesla. If he did nothing more than develop the idea of the rotating magnetic field used in all polyphase induction motors he deserves a place of honor in the hall of electrical fame. He was the first to produce a practicable alternating current motor and he produced it at a time when it was vitally needed. He also invented various forms of arc and incandescent lamps and induction coils and condensers, but none of these were of any unusual importance, at least as compared to his invention of the induction motor.

In his development of the Tesla coil, Nikola Tesla produced a device which produced extremely high voltage high-frequency currents and these produced startling sparking effects. Apparatus of this kind was seen in electrical and physics laboratories for many years, but it never served any really useful purpose. All of these things were helpful however in developing techniques and methods and they added to our sum total knowledge of electricity.

Despite the more than 700 inventions he had to his credit he was not wealthy. He cared little for money and was content so long as he could experiment. He never married and had few friends. In later years he drew more to himself and developed pronounced idiosyncrasies. He was a strict vegetarian and his food was specially prepared for him.

Nikola Tesla was a strange self-centered character. The modern electrical world will little note his passing and while much of what he tried to do ended in failure, he must be given credit for at least one very important thing and that is the invention of the induction motor and his conception of the rotating magnetic field. For that alone he deserves prominence in the history of electrical engineering.

◆ **BEFORE OUR NOSES** . . . Ever since alternating current transmission and distribution came into general use, electrical engineers have tried to develop a successful variable-speed alternating current motor. All sorts of schemes were tried, some quite successful, but none of them ever really had the desirable speed characteristics of the simple direct current motor.

Then came the electron tube, the first in the radio field and more recently in industry, and with the electron tube the investigators began to learn some new tricks. It was found, for example, that a direct current motor could be supplied from an alternating current circuit through an electron tube rectifier. Also, as development proceeded, it was found possible to vary the output of the rectifier between zero and full load with certain types of control circuits.

Before very many people realized it, we had what we had been looking for, an alternating current motor with the speed characteristics of a direct current motor, only it was the same direct current motor we had had for years. With electronic control, however, such as described in the article in this issue on page 64 the direct current motor is more flexible and has better speed characteristics on alternating current than it ever had on direct current circuits. At present such electronic systems of control such as described in this article are available only for medium size motors, but with the principle well understood and with further development in the design and production of electron tubes, it is almost certain to be extended to the use of larger motors. This development is well worth attention.

Effective Use of Wood Waste

Additions made to the power plant of the Lane Co., Inc., at Altavista, Va., nationally known manufacturers of cedar chests, solves a difficult problem of wood waste disposal and also reduces the purchased power requirements of the plant

IN June, 1941 The Lane Co., Inc., Altavista, Va., finding itself faced with the possible loss of its purchased power supply, on account of growing needs for power in war industries, also the necessity of disposing of large and increasing accumulations of slabs and other combustible wood wastes, decided that the time had arrived when something would have to be done in the way of extending its power generating facilities to insure against a curtailment in factory production and to solve the problems and hazards due to mounting piles of slabs on the plant property. The remedy for the situation was obvious—to install additional boiler and generating equipment of capacity sufficient to supply all steam and power requirements and of such efficiency that, under normal operation, the wood wastes would produce the required steam and power without the necessity of burning coal to supplement steam production.

Studies were hurriedly made of the amount of wood wastes normally produced and of the steam and power required for factory operation, including steam for process and kilns and for space heating in winter, after which a decision was arrived at as to the capacity and type of additional boiler and generating equipment that would be needed to meet the conditions and best serve the purposes, keeping in mind the possibilities of future growth. At the same time consideration had to be given to the type of equipment available under the existing circumstances. The problem was not an easy one, on account of the exigencies of the situation, and an overall view and judgment had to be quickly made.

Uniflow Engine Offered Best Solution

The comparative cost, relative efficiency and operating advantages and disadvantages of uniflow engine-generator units and non-condensing and bleeder type turbine generator units were studied, along with the problems of steam pressure and temperature, condensing water supply (natural or cooling tower) that would be required in the case of bleeder turbines for condensing operation, boiler feedwater supply, etc., all of these problems being affected to a considerable extent by the necessity for continuing in operation the existing boiler and engine-generator equipment. The final decision in favor of a uniflow engine-generator installation was further affected by the question of availability of different types of power generating equipment. Operating results since the starting of this new equipment in service, in the early part of May of last year, have satisfied the owners of the wisdom of the decision that was made.

Before the recent additions were made the plant equipment was comprised of two old 297-hp., 12 ft. wide by 12 ft. high, Babcock & Wilcox Co., straight-tube boilers built for 160 lb. pressure (no superheat), and three 2300-v., 3-phase, 60 cycle engine-generator units of 50, 80 and 360 kw. capacity, respectively. These units were operated in conjunction with purchased power supplied by the Virginia Public Service Co., the peak load on the day shift being about 1100 kw. of which approximately half was carried on purchased power.

The two old boilers were set with front headers 9 ft. above the floor line and provided with Dutch ovens and Hofft inclined grates. The wood refuse, consisting of sawdust, shavings and hogged wood, was fed to the furnaces by Allington and Curtis screw feeders. These boilers were equipped some years ago with water-cooled bridge walls to lower furnace temperatures and reduce brickwork maintenance, which was excessively high due to the very restricted furnace space, resulting in a heat release per cubic foot of furnace volume in excess of 55,000 B.t.u. per hr.

A weighed water and fuel test, made on June 28, 1941, before the new plant equipment was purchased, showed that the average normal steam rate of the old engine units was of the order of 43.3 lb. per kw-hr., and that the efficiency of the old boiler units under regular operating conditions (upward of 200 per cent of rating) was approximately 55 per cent. The average heat value of the wood refuse, as fired, was found to be 8145 B.t.u. per lb. (9050 B.t.u. per lb. dry material). With a larger boiler, providing adequate furnace volume and longer gas travel, an efficiency

Contrary to the situation surrounding the operation of most power plants, here is a plant where the accumulation of fuel threatened to become a burden. The fuel was the wood waste resulting from the large scale manufacture of cedar chests for which the Lane Co. is noted. The remedy, of course, was quite obvious; it involved the installation of additional boiler and electric generating capacity in the power plant, but the working out of the details of the new installation by Albert C. Wood, consulting engineer of Philadelphia, as described here, proved very interesting. Not only was the wood waste disposal problem solved effectively but the resulting increase in generating capacity made it possible to materially reduce the amount of power purchased from the local power company. The net overall cost of purchased power was reduced from a figure of over $26,000 per yr. to $183 per mo. during the first 6 mo. of operation of the new installation. Surplus power is delivered to the power company under a power interchange agreement

Cuts Purchased Power Needs

Fig. 1. View of the 590-hp. Union Iron Works boiler showing the Hofft fuel storage bin and feeder equipment discharging through the front wall of the Dutch oven furnace extension

of upwards of 70 per cent was believed to be entirely possible.

The equipment recently installed comprised a 590-hp. Union Iron Works boiler built for 200 lb. working pressure, an 800-kw. (80 per cent p.f.) Skinner uniflow engine-generator unit with V-belt driven exciter, a 50,000 lb. per hr. Cochrane deaerating feedwater heater, and a new Union Steam Pump Co., 10 in. by 6 in. by 12 in. duplex, piston pattern boiler feed pump, to supplement two existing 9 in. by 5¼ in. by 10 in. Worthington duplex feed pumps. Other appurtenant equipment included a Copes feedwater regulator, Brown Instrument Co. steam flow meter, CO_2 meter, draft gages and stack temperature recorders, two Ingersoll-Rand, 2-R V-1½, motor-driven booster pumps, for increasing the head on the float-controlled make-up valve of the Cochrane heater, a 12-in. vertical receiver-separator, a 16-in. Swartwout oil separator, a 14-in. Davis back pressure valve and a 16-in. Swartwout exhaust head.

Blank Panel Added for Future Use

A new generator panel and a blank panel for future feeder were added to the existing switchboard. The equipment on the new generator panel, which was furnished by the General Electric Co., comprised indicating volt, ampere and power factor meters, a watthour meter, exciter rheostat, and a FK-143 oil circuit breaker, together with the usual current and potential transformers and control accessories. On a swinging bracket attached to the generator panel were mounted a synchroscope and a voltmeter for the incoming unit.

The installation of the new boiler and engine-generator unit required the construction of additions to the boiler and engine rooms. These building additions were constructed of concrete, brick and steel, with fireproof roofs, ventilated side wall sash, and swinging steel sash ventilators on one side near the roof line. Concrete walled ducts, covered by checkered steel floor plates, were constructed for blow-off and other under-floor piping.

Stairways, platforms and catwalks were provided in the boiler house for affording access to soot blowers, feedwater regulators, and other boiler accessories and to the new feedwater heater, etc. A suspended steel-grating walkway from the boiler house, across an intervening compressor and filter room, to the new engine room addition was included to provide a direct passage between the boiler and engine house buildings. An adequate and carefully planned lighting system was also included in the building additions.

The new 590-hp. Union Iron Works boiler is of the 3-drum bent tube type with water-cooled front and bridge walls, designed for operation at 250 per cent of rating. The boiler setting, which is 11 ft., 6 in. wide inside, includes a Dutch oven and provides a total furnace volume of 1896 cu. ft. The furnace linings are of Dialite brick, 13½ in. thick. The same high alumina brick was used throughout for setting linings, as previous experience, in the case of the old B. & W. boiler settings had shown that less difficulty from erosion and spalling resulted with this type of brick than with any other that had been tried.

The furnace fronts and hand

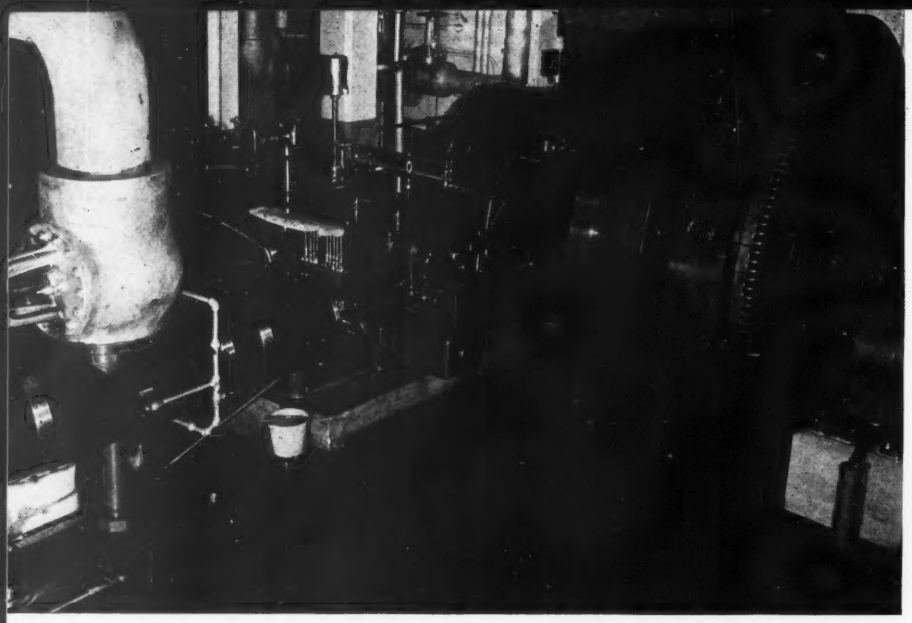


Fig. 2. Side view of the 800-kw. Skinner Universal Unaflow Engine-Generator unit

operated stoker equipment were furnished by the M. A. Hofft Co. This equipment comprises an 8-ft. long inclined, manually operated, shaking grate of heavy construction with a dumping section 18 in. wide, also manually operated. The total fuel burning area is approximately 109 sq. ft. Supplementary air admission grates overlaid by a brick checkerwork are installed at the rear of the bridge wall. The air supply to these grates is regulated by doors at the sides of the setting. Under normal operating conditions very little fuel accumulates on the stoker grates, the major part burning in suspension.

The boiler is operated under natural draft, afforded by a 150-ft. high radial brick chimney which serves all three boilers in the plant. Four firing doors of the inwardly swinging type, at the front of the Dutch oven, make possible the use of coal. However, little or no coal is normally burned, the wood refuse from the factory being sufficient to supply all steam requirements. The new boiler is equipped with five valve-in-head soot blowers furnished by the Diamond Power Specialty Co.

The fuel feeding equipment furnished by the M. A. Hofft Co. is of special design and comprises a large steel plate storage bin having sloping sides (to prevent arching) and a nest of screws at the bottom for moving the wood refuse to the inlet ends of three screw conveyors which convey the fuel forward and discharge it through star feeders into the front end of the Dutch oven.

The feeding equipment is operated by electric motors, sprockets and gears through the medium of a Reeves variable speed drive which is automatically controlled according to the steam pressure. The storage bin of the Hofft feeder is supplied with wood refuse by a large, new, cyclone collector, furnished by Kirk & Blum Mfg. Co., Cincinnati, Ohio, and installed on structural supports above the boiler house roof. This collector receives and separates the pneumatically conveyed sawdust and shavings from various wood working machinery in the factory, also the hogged slab refuse. The new collector is set at such a height that it can supply by gravity the storage bins of the Allington & Curtis feeders and the Hofft feeder as well.

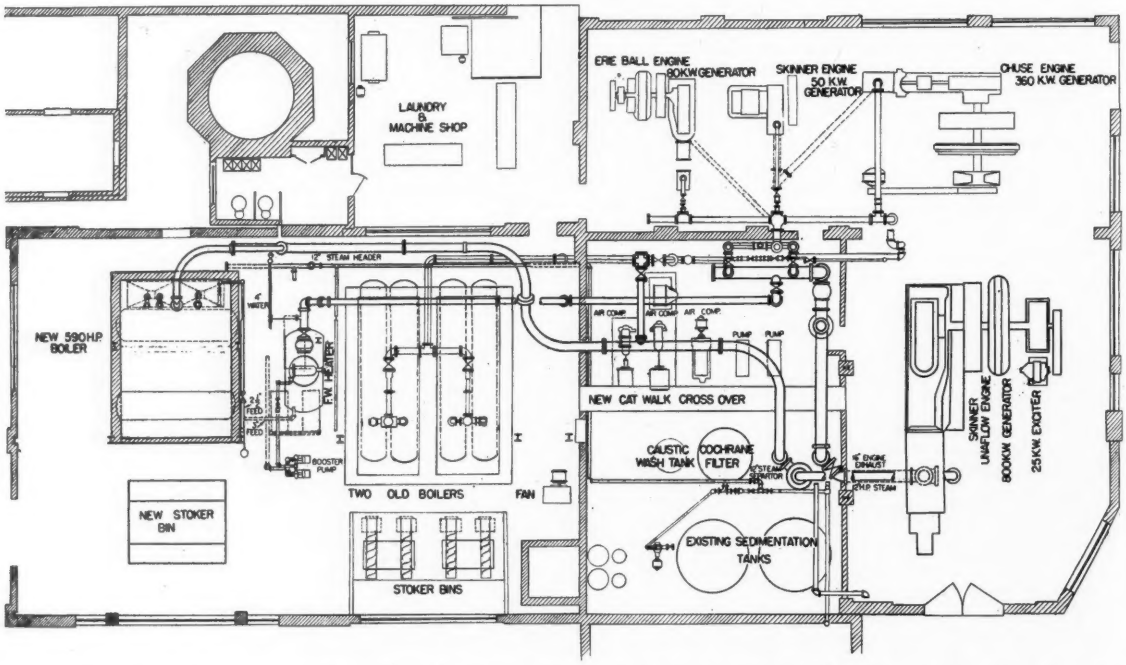


Fig. 3. Plan showing the arrangement of equipment in the Lane Co. power plant. The new boiler is at the extreme left and the new engine at the extreme right. Note the new 12-in. high-pressure steam header

The Skinner Universal Unaflow engine-generator unit is of the poppet valve side crank, heavy duty type, direct connected to an 800-kw., 80 per cent p.f. 2300-v., 3-phase, 60 cycle, 150 r.p.m. General Electric generator, equipped with a 25-kw., 125-v. V-belt driven exciter. The cylinder diameter is 33 in., and stroke 36 in. The total weight of the unit is of the order of 164,600 lb., the weight of the engine alone being approximately 136,000 lb.

35,000 Lb. Governor Wheel

The weight of the governor wheel which is 10 ft., 6 in. diam. by 24 in. face is 35,000 lb. The engine was designed for a throttle pressure of 145 lb. and an exhaust pressure of 5 lb. The steam inlet is 12 in. diam. and the exhaust outlet 16 in. diam. The crank pin is 10⅝ in. diam. by 8 in. long, wrist pin 7¼ in. by 10⅜ in., main bearing 16 in. by 28 in. and outboard bearing 14 in. by 24 in. The piston is of the floating type with tail rod, guide and cross head. The piston and tail rod diameter is 8 in. The engine is equipped with a complete pressure lubricating system including oil filter, oil cooler and circulating pump. The guaranteed steam rate at full load is 35.1 lb. and at ¾ load 33.1 lb. The engine is of ample capacity for 25 per cent overload. The design M.E.P. at full load (800 kw.) is 56 psi.

The engine-generator unit is set on a massive, monolithic concrete foundation having a base area of 853 sq. ft. and volume of 221 cu. yd. The total weight of this foundation is approximately 448 tons, which with the weight of the engine-generator unit produces a soil load of 1245 lb. per sq. ft.

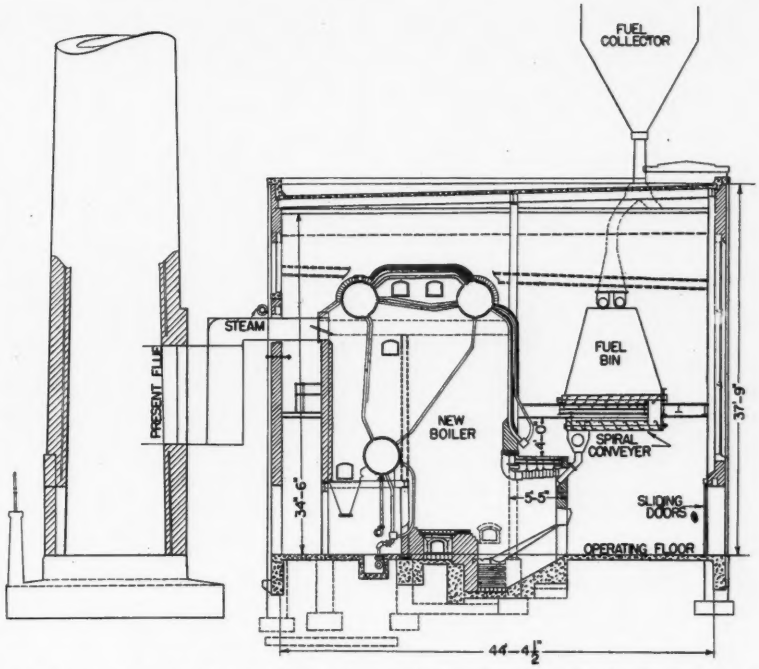


Fig. 4. A section through the plant at the new boiler. This shows the details of the fuel handling system and the design of the wood burning furnace

The new 50,000 lb. per hr. Cochrane deaerating feedwater heater is of the storage type, having storage shell 54 in. diam. by 9 ft., 4½ in. long, with heater section 42 in. diam. by 3 ft., 9½ in. high, mounted on top. The heater is provided with 3-in. float controlled make-up and 4-in. overflow valves, and a 10-in. oil separator in the steam inlet connection. The heater is mounted on structural steel supports at such a height as to afford a static head on the boiler feed pumps of 14 ft., 3 in. The temperatures of the steam in the heater section and of

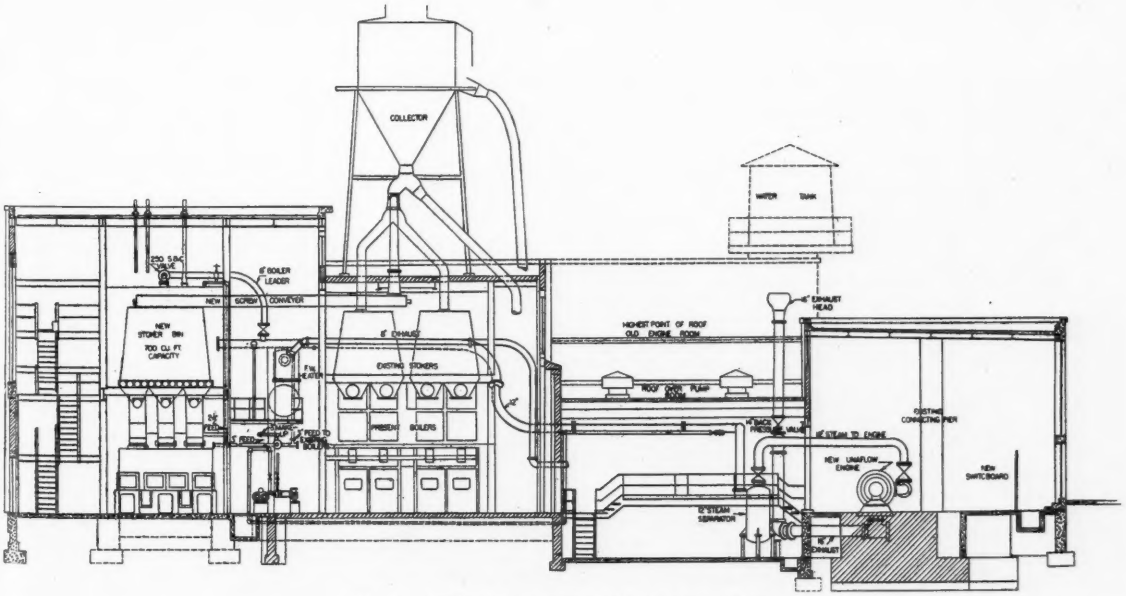


Fig. 5. Longitudinal elevation of the power plant

the effluent therefrom are substantially identical at all times indicating practically perfect deaeration.

Piping Arrangement

The piping work comprising a 12-in. steam supply line from the new boiler to the Skinner engine (interconnected with the existing 8-in. header in the old engine room), a 16-in. exhaust line from the new unit, with valved connections to the factory exhaust steam supply system, an 8-in. exhaust steam supply line to the new heater, and various feed pump, heater, blow-off and drain connections, was supplied and installed by Chas. M. Brown & Co., Philadelphia, Pa., the fabricated work, valves and other piping materials being furnished by the Crane Co.

All high-pressure piping is of 250 lb. standard and all exhaust and low-pressure piping of 125 lb. standard. Substantially all of the larger piping was prefabricated from shop details, so that a minimum of field work would be required. Piping work 2½ in. and larger in size was made up with lap joints and rolled steel, swivel flanges. The insulation work was furnished and applied by the Ehret Magnesia Mfg. Co.

All the work in connection with the new plant additions was carried out under the stress of existing and impending government restrictions on materials and equipment. Fortunately, however, the major equipment and the more important building materials were ordered and acquired in time to permit the completion of the project without serious delay.

During the 12-mo. period prior to the starting of the new plant equipment in service The Lane Co. purchased from the Virginia Public Service Co., 1,732,400 kw-hr. of energy at a cost of $27,035, and sold back to them approximately 133,400 kw-hr. resulting in a net overall purchased power cost of $26,501 per annum.

Since the new equipment was started in service the plant load has increased considerably, but notwithstanding this the net cost of purchased power has been reduced to approximately $183 per mo., the amount of power purchased per month averaging 14,800 kw-hr. as against 41,200 kw-hr. sold to the power company. For all surplus power supplied to the power company, The Lane Co., Inc., receives 4 mills per kw-hr. The interchange arrangement with the power company is being continued since it affords stand-by service at a reasonable cost. Parallel operation with the power company's system is further advantageous since it insures a regulated frequency and takes care of heavy load swings in the starting of large motors. Furthermore, it smooths out the operation of the boilers and makes it possible for The Lane Co., Inc., to advantageously dispose of surplus wood waste.

The plant improvements above described were planned and supervised by Albert C. Wood, consulting engineer, Philadelphia, Pa. The building additions and the boiler and engine foundations were constructed by C. L. Lewis, General Contractor, of Lynchburg, Va., the structural and reinforcing steel and the steel sash being purchased under separate contracts.

The boiler erection and setting work was done by the J. L. Hamilton Engineering Co., Charlotte, N. C., all refractory material except the Dutch oven arch being supplied by the Harbison-Walker Refractories Co. The steel supported Dutch oven arch was purchased from the Bigelow-Liptak Corp.

The major part of the heavy rigging and installation work and various underground piping changes were carried out under the direction of H. H. Bowers, plant operating engineer of The Lane Co., Inc., to whom much credit is due for the timely and successful completion of various details of the project. To E. H. Lane, president, and L. K. Loftin, treasurer, is also due much credit for their helpful judgment and cooperation in arriving at quick decisions, and for their energy and driving force in getting contracts and orders placed, obtaining necessary priorities and in following up deliveries of materials and equipment.

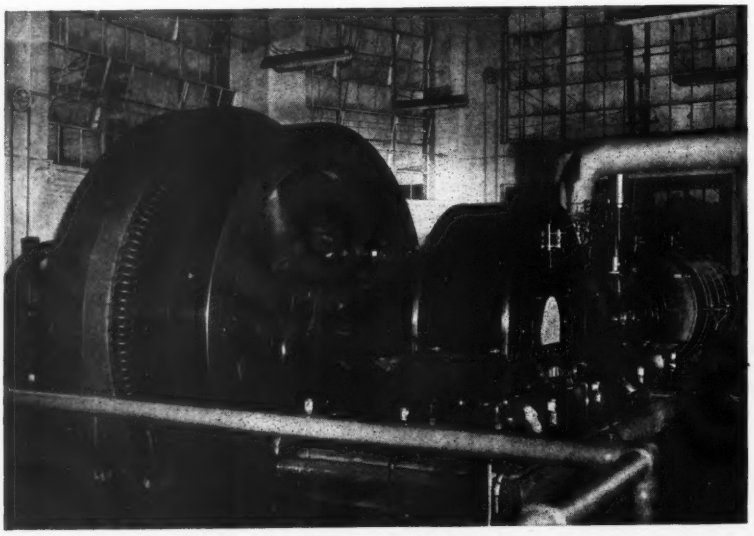


Fig. 6. A front view of the new 800-kw. engine generator

FIRST GAS TURBINE LOCOMOTIVE

In reporting the development of the first gas turbine locomotive at the December, 1942, A.S.M.E. meeting, Paul R. Sidler, Resident Engineer of Brown, Boveri & Co., Ltd., stated that while it is clear that the gas turbine locomotive is not yet a serious competitor of the Diesel locomotive, it is evident that in certain classes of service it may show marked advantages. Mr. Sidler presented data compared with previous figures presented by E. E. Chapman on steam and Diesel electric locomotives. These figures showed approximate cost per horsepower: steam $35; Diesel $87; gas turbine $65. Efficiency at drawbar: steam, 6 to 8 per cent; Diesel, 26 to 28 per cent; gas turbine, 15 to 16 per cent. Fuel costs: steam, 100 per cent; Diesel and gas turbine, 50 to 75 per cent. Lubrication costs in per cent of fuel costs: steam, 10 per cent; Diesel, 20 to 30 per cent; gas turbine, less than 5 per cent. Water costs in per cent of fuel costs: steam, 10 per cent; Diesel, small; gas turbine, nothing.

Condition of elevator rope after 10 yr. of service with no lubrication whatever. Note compressed condition of the hemp core

It Pays To Oil Your Elevator Ropes

By F. L. SPANGLER

DURING a survey made by the writer 2 yr. ago among a number of Chicago office buildings, half of the building engineers and building managers interviewed said that they did not lubricate the ropes on their electric traction elevators. The chief reasons given for not lubricating were: (1) lubricant on the rope would reduce the traction between the hoist cables and the traction drums, thereby inducing slippage, and (2) since the ropes operated inside a building and were not exposed to the elements or to wide changes in temperature, the original lubricant applied at the factory was sufficient for the natural life of the ropes.

However, it should be noted that those who were applying lubricant to their elevator ropes reported no undue slippage of the ropes over the traction drums. Such reports must have been true since if slippage were experienced these buildings would certainly no longer have continued the practice of lubricating their hoist cables.

If the proper rope dressing is applied frequently but sparingly, there seems to be little likelihood that it would create a dangerous condition because of slippage. If a tendency to slip becomes apparent, the type of lubricant used might be at fault. The presence of a small amount of resinous compound in the lubricant is more likely to prevent slippage than promote it.

As to whether traction elevator ropes require lubrication, some light is thrown on this matter by an examination of a hoist rope recently taken off a high-rise passenger elevator. This rope had been in regular service for 10 yr. before it was removed. In all those years, no lubrication was applied, so the hemp core naturally showed a dry condition, and some rust was evident on the inside wires.

This was a 6 by 19⅝-in. traction steel, preformed rope. An examination revealed that the core had lost practically all of its original elasticity resilience and strength. In this dry state it permitted the strands to embed themselves deeply within the core. In this condition, the functioning of the core as a support for the wire strands had been almost entirely lost.

Since the strands compacted together into the core, the diameter of the rope was necessarily reduced and adjacent strands were bound tight against each other. Hence, the strands did not have the freedom of action that characterized the rope when it was new, and pinching between strands resulted in interstitial or valley breaks in the outside wires. It is interesting to note that in the length of rope examined (about 3 ft.) virtually all the wire breaks were of this kind, and only one crown break was evident. Hence, bending fatigue was a very minor factor, the rope still being in excellent condition from a strength standpoint.

Of greater importance to rope service, however, was the fact that this rope had been reduced about 3/32 in. in diameter during its 10 yr. service. This in itself would not have any material effect on the life of the old rope, but it imposes a

(*Continued on page* 73)

A NEW ELECTRONIC VARIABLE-SPEED DRIVE

Here is the story of a development that opens up a new chapter in the history of speed control; naturally it is a story that deals with electronics. Designed for use on alternating current circuits this drive nevertheless uses a direct current motor. This motor is supplied from a rectifier, the output of which can be controlled between any desired limits from full off to full on. The speed of the motor can be preset at any desired value. It is possible to vary the accelerating current to bring the motor up to speed in the quickest time consistent with the nature of the load. The motor pulls up to speed with smooth, uniform torque and then the current drops off to a value needed to maintain required torque. Startling? Well, these are only some of the things this versatile electronic system will do

By S. D. Fendley, Electronic Section, Industrial Control Division, General Electric Co.

THE EXPERIENCE and knowledge obtained from the use of thyratron-tube motor control for more than a decade has made possible the development of a new electronic variable-speed drive with features and characteristics that make it ideally suited to a vast number of industrial applications. The versatility of this new drive which has already been applied extensively, is made possible by a new electronic control system, called Thy-mo-trol.

One of the earliest applications of electronic motor control was to the operation of an automatic lighting control installed about 1928. In this application, thyratron tubes were used to supply both the field and armature of a small motor to control its speed over a range of approximately 100 to 3600 r.p.m.

The primary function of practically all of the original motor controls has been to adjust the speed of the motor. The other requirements such as starting, accelerating, etc., have been obtained largely through the use of various combinations of conventional control devices. A few equipments have been supplied for holding the motor speed constant, but in general their principal function has been to supply smooth adjustable speed.

Generally speaking, these equipments consisted of an adjustable-voltage rectifier using thyratron tubes to supply the direct current for the field and armature of the motor. By varying the output voltage of the tubes the speed of the motor can be changed. Some type of feed-back system is employed to do this, and it may be of either the mechanical or electrical type.

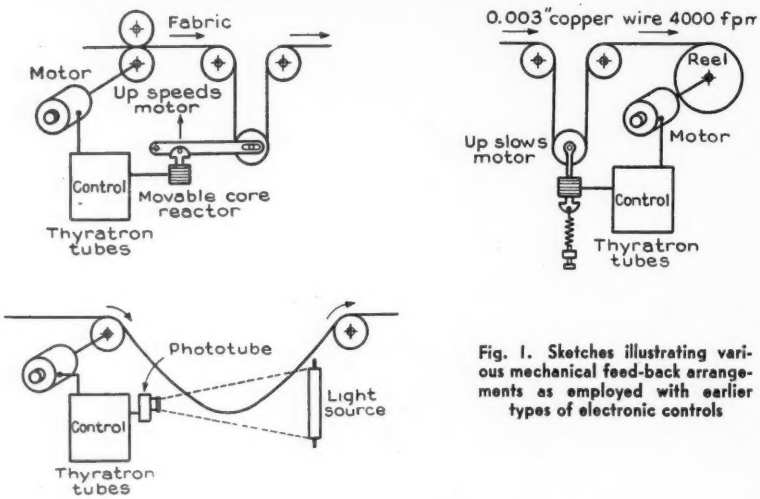


Fig. 1. Sketches illustrating various mechanical feed-back arrangements as employed with earlier types of electronic controls

The phase-shift method is one of the most common ways to vary the output voltage of a thyratron tube. This employs the use of a resistance-reactance bridge which permits the phase relation of the grid voltage to be varied with respect to the anode voltage. By varying one of the elements in the bridge circuit, it is possible to change the phase displacement of the grid voltage with respect to the anode voltage from a condition where the two are completely in phase to the point where they are 180 deg. out of phase. When the two voltages are completely in phase, the tube will be turned full on. When they are completely out of phase, the tube will be turned off completely and will not conduct any current. By varying the voltage relation between these limits the tubes can be turned on to any desirable degree.

Feed-Back Arrangement

Two methods of feed-back are available, the mechanical and electrical feed-back systems. In a mechanical feed-back system, one of the elements in the phase-shifting bridge, usually the reactor, is varied mechanically to change the output of the tubes and thus regulate the speed of the controlled motor. Several arrangements of this type are shown in Fig. 1. In one of these, a loop of material being processed—this may be fabric, rubber sheeting, sheet steel, etc.—is used to operate the movable core of the reactor which thus varies the speed of the motor in proportion to the rise and fall of the loop.

In some instances, where it is

not practical to use a mechanical arrangement employing the reactor, the motor speed can be controlled through the use of a photoelectric arrangement as shown in the lower sketch in Fig. 1. A light beam is directed on the loop of material, and as the loop rises and falls it varies the amount of light falling on the phototube. This causes the motor speed to be increased or decreased through the use of the thyratron tubes in the same manner as with the reactor scheme.

The basic circuit for all equipments of this type employs two thyratron tubes to supply direct current to the motor field. The field voltage is varied by changing the position of the core in the reactor. Within the rating of available tubes, similar equipment can be used to control armature voltage.

a pilot generator with a suitable circuit, makes it possible to hold the speed of a motor very nearly constant over a wide range of loads. As in the mechanical arrangement, a full-wave rectifier is used, but a saturable reactor instead of a movable core reactor varies the output of the voltage on the motor.

Fully Automatic Control— Thy-Mo-Trol

Our experience with the type of equipment just described has resulted in the development of the Thy-mo-trol system. This control in combination with a suitable motor provides an adjustable-speed drive with features which are not ordinarily found in other conventional drives.

This electronically controlled motor drive was not developed with the idea that it can or will

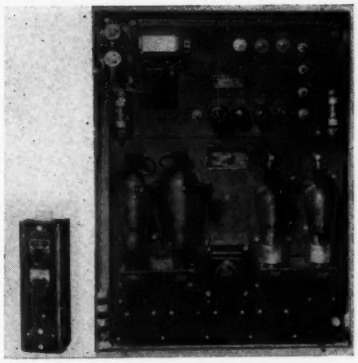


Fig. 2. Thy-mo-trol panel (right) and heavy-duty-type push button station. These together with an anode transformer and a d.c. driving motor comprise the standard Thy-mo-trol drive

The standard drive of this type consists of an anode transformer, a control and rectifier panel, a push-button station or other control accessory, and a direct cur-

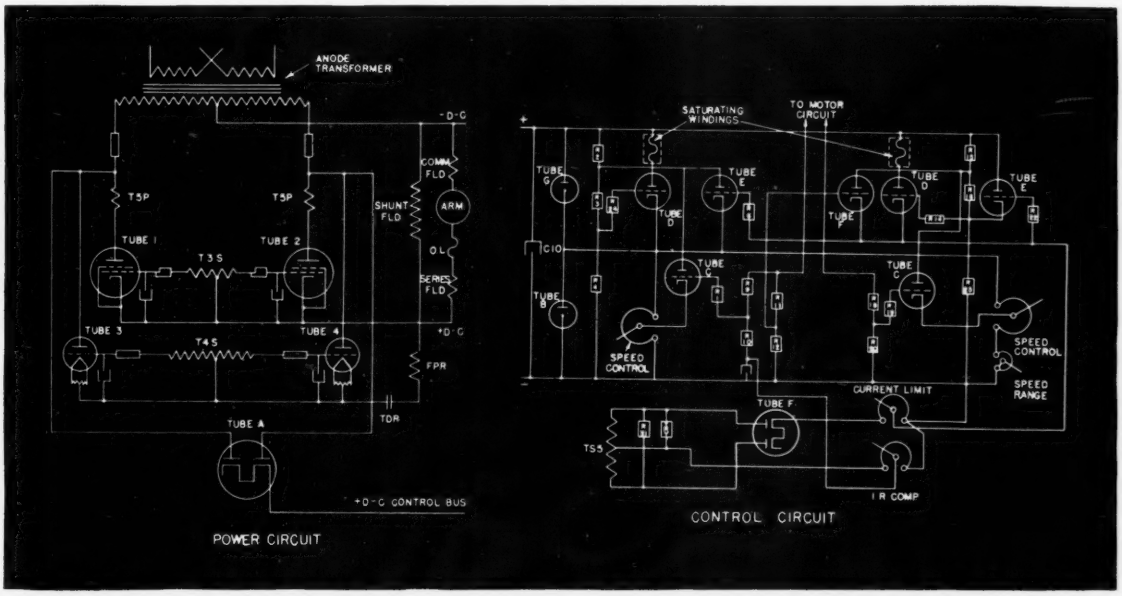


Fig. 3. The power circuit

Fig. 4. The control circuit

Typical of the applications employing this type of control is the maintaining of constant tension in the reeling of wire, ranging from fine copper wire to large, heavy cable. Another similar application is that of synchronizing the speed of conveyors with that of a material in a plastic state as it emerges from an extruding machine, and for maintaining a fixed relationship between two or more conveyors which must handle the same material.

Where speed regulation is an essential factor, the electrical feed-back arrangement, utilizing supplant the various other types of mechanical and electrical drives in use today, where such drives have the characteristics and provide all the features needed. The development has been carried on rather to evolve an electronic drive providing features not inherent in conventional drives where close speed regulation, smooth acceleration, precise control of speed, and other similar features are desirable. However, it is believed that this type of drive offers both the user and builder of machinery an equipment ideally suited to his needs.

rent driving motor, and in some instances a smoothing reactor.

The anode transformer is used in order to make use of motors of standard voltage. The transformer is of conventional design and may be either of the insulating or of the auto-transformer type. It is generally supplied as a separate item to keep to a minimum the size, weight, and cost of the rectifier cabinet in which it might otherwise be located.

Figure 2 (right) shows a conventional type of control panel. It consists of a suitable base on which is assembled the control

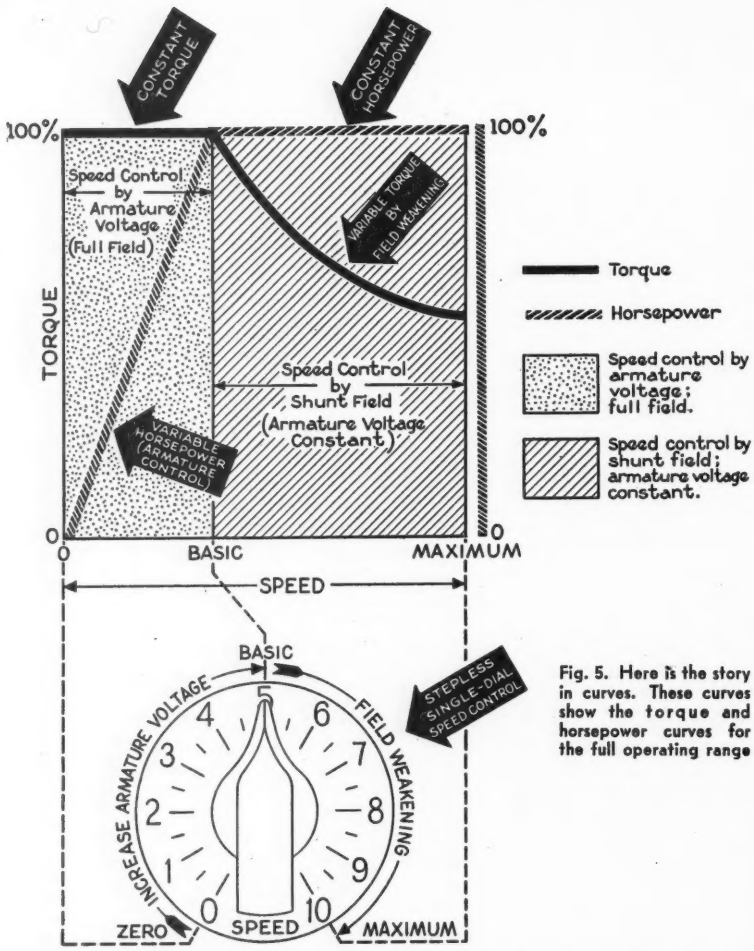


Fig. 5. Here is the story in curves. These curves show the torque and horsepower curves for the full operating range

and power tubes, a line contactor, a thermal overload relay, a field-failure relay, a cathode-protective timer and the necessary transformers, and other material required for the electronic circuit.

The control accessory (Fig. 2—left) is a standard heavy-duty-type push-button station in which are mounted the necessary number of momentary contact units and the speed-adjusting potentiometer. Both the speed-adjusting potentiometer and the momentary control units may be supplied as separate items which the user can mount in any convenient location.

Direct Current Motor Is Used

A shunt-wound direct current motor is used. In order to make more economical use of the rectifier tubes, 230-v. machines are ordinarily supplied. Although the motor is of conventional design, its characteristics must be such that it will operate satisfactorily from an unfiltered rectifier supply. This is particularly true when the alternating current power supply is single-phase.

ACCELERATION. One of the characteristics of a good drive is that it should be capable of starting its load with a minimum of shock to the machine and under conditions which will permit the motor to commutate satisfactorily. From an engineering point of view, the accelerating scheme employed in this drive is one which does approach this ideal. It is termed constant-current limit acceleration. By means of an adjustment in the panel it is possible to vary the accelerating current and thus the accelerating torque to a value which will bring the motor up to operating speed in the quickest time consistent with the nature of the load and the commutating ability of the motor. From the moment the start button is pressed, the motor will assume a maximum value of current as determined by the adjustment. Under these conditions the motor will pull with smooth, uniform torque until the load is up to speed; then the current will drop off to the value needed to maintain the required torque.

PRESET CONTROL. For many applications, it is desirable to preset the speed at which the motor is to operate anywhere within the operating range. This type of equipment provides this feature so that the motor will be accelerated smoothly up to the speed called for by the setting of the potentiometer. The motor is always started under full-field conditions regardless of whether the potentiometer is set for operation below base speed by armature voltage control or above base speed in the field weakening range.

OVERLOAD PROTECTION. Protection against sustained overload is provided by means of a conventional thermal overload relay.

STOPPING. Quick stopping of the motor is provided by means of conventional dynamic braking. When the stop button is pressed, the power is disconnected and a resistor is connected across the armature.

REGENERATION OR PUMP-BACK. The standard equipment does not provide for regeneration or pump-back, so that when the speed-adjusting potentiometer is quickly turned from a high setting to a lower one, the motor will coast down to the new setting at a rate which will be determined largely by the friction of the load. This means that it is not suitable for use with overhauling loads.

Another factor is that when motor speed is being reduced with field applied, the motor acts as a generator and generates an excessively high voltage. In the Thy-mo-trol system, a voltage-snubbing circuit automatically keeps the voltage down to a safe value. Where quick slow-down is required, a modification can be furnished which provides a form of automatic dynamic braking to slow down the motor.

SPEED-RANGE. The speed-range obtainable with equipment of this type is largely a function of the size and type of motor employed. The range, theoretically, is something from a value approaching zero up to the maximum for which the motor is designed to operate by field weakening. The practical limits are largely determined by the heating and stability of the motor. From tests which have been made it appears that the motors can be operated over a range of up to 20 to 1 below base speed by armature control on an intermittent basis without exceeding a dangerous temperature rise, and as high by field

control as the motor is designed to operate. Much, however, depends upon the nature of the load to be handled, the duty cycle, etc.

By providing closely regulated armature voltage and automatic compensation for IR drop, this system holds the motor speed constant within close limits, independent of load and ordinary line-voltage variations. An adjustment in the panel makes it possible to adjust the regulation to provide a drooping speed characteristic where this is desirable.

For a given speed setting the equipment can be adjusted to hold the regulation to a value of approximately 2 per cent variation from no load to full load when operating below the basic motor speed. When the motor is operating in the field weakening range, the speed will decrease with load, to a value not exceeding 10 per cent depending upon the rating of the drive.

The close regulation provided with the system makes it possible to operate the motor on a constant torque basis below base speed at any speed within the stable operating range. This means that it is possible to get a motor to operate at some low speed such as 100 r.p.m., for example, and maintain this within close limits even though the load may vary from no load to full load.

For applications where a more precise speed regulation is desired than that obtained with the standard equipments, it is possible to use the output voltage of a tachometer generator in the circuit and obtain a speed regulation on the order of plus or minus ½ per cent from no load to full load. This arrangement provides exceptionally close regulation regardless of line voltage variation. Certain types of testing equipment often demand regulation of this low magnitude.

Effects of Alternating Current Voltage Variation

The system will operate successfully on line-voltage variations of as much as 10 per cent of rated voltage, but to obtain maximum tube life the variation should not exceed plus or minus 5 per cent. For a plus or minus 5 per cent line-voltage variation, tests have indicated that when operating over a range of from 5 per cent of base speed up to 2 to 1 by field control, the speed will not vary more than plus or minus 1 per cent.

In this system, the circuits have been so designed that the equipment is entirely safe regardless of which tube or combination of tubes may fail. The equipment will either shut down instantly or will continue to operate, deprived of the function of the tube which fails.

All of the inductive circuits in the system which might be injured due to excessive voltage are protected by Thyrite units which keep the voltage rise down to safe limits.

Principle of Operation

The operation of the equipment can best be understood by considering individually the part which makes up the power circuit and that which constitutes the control circuit.

From the diagram shown in Fig. 3 it can be seen that a pair of tubes (Tube 1 and Tube 2) constitutes a full-wave rectifier which converts to direct current the alternating current supplied by the anode transformer. The direct current is then fed through the armature of the motor. Likewise, Tube 3 and Tube 4 make up a full-wave rectifier, which supplies direct current to the shunt field of the motor. By varying the outputs of these two rectifiers, it is possible to control the operation of the motor. Its speed can be varied from zero, by armature-voltage control, up to maximum for which the particular motor is designed to operate by field weakening.

Electronic Control Circuits

The means by which the output of the power rectifiers is varied is a group of radio-type control tubes, whose basic circuit is shown in Fig. 4. Acting as amplifiers of current and voltage signals received from the motor circuit, these tubes supply the necessary direct current to the saturating winding of the saturable-core reactor in the resistance-reactance bridge which is used to vary the output voltage of the power rectifiers by the phase-shift method previously described. By varying the current in the saturating winding, the power tubes are turned on or off as required to give the desired motor performance.

To provide for the current-limit acceleration of the motor, a current transformer, T5, is used. This has two primary windings connected in the anode circuit of the two power tubes supplying current to the motor armature. The design is such that an alternating current voltage is produced in the secondary, proportional to the current flowing through the thyratron tubes. The alternating current voltage is rectified and connected into the circuit in such a way that when it reaches a value as determined by the setting of a potentiometer, it will have the effect of turning off the armature tubes, thus reducing the voltage on the armature and maintaining the current at a fixed maximum value.

If the control had been set to operate the motor in the field-weakening range, the current-limit control acting through a suitable tube will maintain full field until the armature current starts to reduce. Thus, during acceleration under these conditions the motor will always accelerate from zero to base speed with full field. At this point, the field will be weakened gradually until the motor reaches the preset field weakened speed. Then the armature current will drop to the value necessary to drive the load.

The adjustment of the speed is controlled by two adjustable potentiometers — one controls armature voltage, the other controls field voltage. The potentiometers are operated from a single shaft and are arranged so that approximately half of the rotation of the

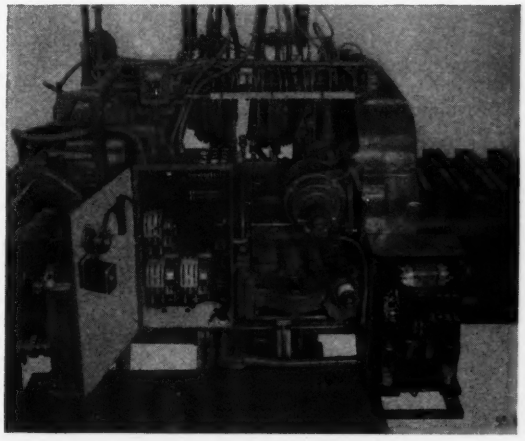


Fig. 6. Standard Thymo-trol panel (lower right) mounted on milling machine for milling airplane spars. Electronic control on this machine is used to control the d.c. feed motor. The a.c. control panel (left center) controls other applications

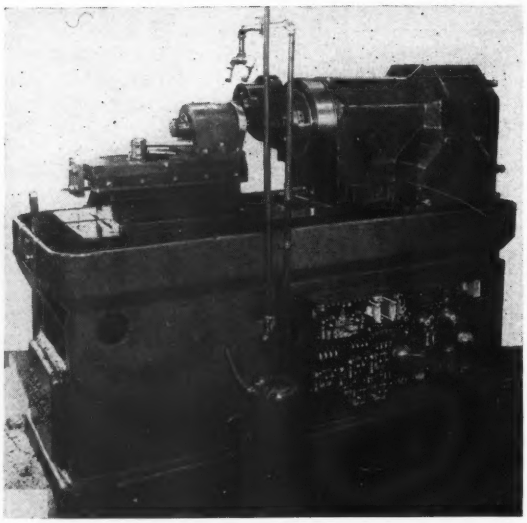


Fig. 7. Built-in application of Thy-mo-trol to "Plan-O-Mill" form and thread milling machine

adjusting knob will vary the armature voltage from approximately zero to maximum. Then the other potentiometer becomes effective, and further turning will tend to reduce the field voltage so that the motor speed can be increased to the value desired, up to the maximum for which the particular motor is designed to operate by field weakening.

To maintain accurately the preset speed, it is necessary to hold armature counter-emf constant. This can be done by increasing the armature terminal voltage by an amount equal to the IR drop of the armature circuit. In this system, this is accomplished through the use of the same current transformer that controls the current limit. The circuit functions in such manner that as armature current increases, the thyratrons in the armature circuit are turned on, thus increasing the armature voltage. If the load increases, the circuit operates to increase the armature voltage proportionally, which thus acts to maintain the speed at its preset level. An adjustable potentiometer used in the circuit makes it possible to maintain essentially constant speed from no load to full load for any given speed setting, or to provide a drooping speed characteristic where desirable.

When the start button is pressed, the motor will be accelerated rapidly and smoothly by current limit as described above until it reaches a speed corresponding to the setting of the speed-adjusting potentiometer. The motor will then maintain this speed closely, irrespective of variations in load, within the limits of the IR-drop-compensation feature. When the stop button is pressed, the anode contactor will be dropped out and a resistor will be connected across the armature to bring the motor to a quick stop as full field is applied. The substitution of a magnetic-reversing switch for the anode contactor makes it possible to reverse quickly the direction of rotation by current-limit regeneration of the motor.

Motor Operating Characteristics

When the motor is operating at speeds below basic, during which it has full-field voltage and reduced-armature voltage, it will provide constant torque. The horsepower output will decrease in proportion to the decrease in speed. When operating at speeds above basic, during which it has full-armature voltage and reduced field voltage, the motor will provide constant horsepower and reduced torque output. This is illustrated by Fig. 5 which shows the torque and horsepower curves for the full operating range. Figure 5 also illustrates how the speed is increased by armature voltage as the speed adjusting potentiometer is turned from zero to midposition, and how the motor operates by field weakening from midposition to the point where the knob is turned to the extreme clockwise position.

Many interesting applications of the Thy-mo-trol drive have been made—most of them to machine tools because of the present limitations in size. Among the types of machines to which drives have been successfully applied are grinders, milling machines, tool room lathes, turret lathes, and thread mills. In addition, they have been supplied for automatic welding machines and for various special equipments for testing magnetos, airplane propeller governors, instrument tachometers. Figure 6 shows a standard Thy-mo-trol panel applied to a milling machine.

A particularly interesting application has been made for driving the headstock on grinders. The wide speed range obtainable and the constant torque characteristics provided at low speed make it possible to provide the right speed for every type of grind. In several instances the new control has made possible a simplification in the headstock itself through the elimination of gears and pulleys formerly required.

Another important factor in this application is that the equipment can be mounted on the grinder without fear of introducing any undesirable vibration such as might be produced with high-speed rotating apparatus. The machine can be made entirely self-contained, and it can be moved at will without worry as to the availability of a direct current power supply.

For reversing table drives, the use of two independent speed-adjusting potentiometers makes it possible to provide full-range, independently adjustable speed for both directions of travel. A simple relay for selection between the potentiometers and a standard double-throw limit switch are all the additional material needed.

Built-In Control

The electronic control can be supplied in a form suitable for building into a machine in the same manner as conventional control equipment. An interesting application of this type is shown in Fig. 7 (cover removed) which shows a panel of this type built into a form and thread milling machine. In this instance, the electronic equipment is combined on a single panel with standard magnetic switches used for starting the coolant pumps, etc. The features provided by the Thy-mo-trol system used on the work spindles have helped to increase production materially by increasing the amount of work that can be done between grinds, increasing the life of the cutter, and by eliminating the necessity for changing gears and sheaves to obtain the necessary range of speed.

Dew Point of Flue Gases Containing Sulfur

Part II

By JESSE S. YEAW and LOUIS SHNIDMAN
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In the first part of this article by Messrs. Yeaw and Shnidman which appeared on page 68 of the January issue, it was shown that the presence of even very small quantities of sulfur trioxide in flue gas has a considerable effect upon the dew point of the flue gas. The determination of sulfur trioxide in flue gas, as the authors point out in this second part of their article, is not very satisfactory because of the equipment needed and the technical skill involved. The authors, therefore, have developed a method whereby the relative proportions of sulfur trioxide can be estimated with considerable accuracy. This somewhat detailed method is described in this installment

THE DETERMINATION of sulfur trioxide in flue gas is not altogether satisfactory due to the fact that it requires special apparatus and a certain amount of technical skill not ordinarily available. Furthermore, the usual presence of a relatively large excess of the unstable sulfur dioxide gas in these flue gas mixtures has always made the final results for sulfur trioxide somewhat doubtful. It is the purpose of this section, therefore, to show how the relative proportion of sulfur trioxide in the flue gas mixture may vary with respect to the fuel itself, and also with respect to its combustion with air.

The two principal factors involved in the estimation of SO_3 in the flue gas are, (a) the division of the original sulfur in the fuel between the volatile part and that part which remains in the ash, and (b) the distribution of the volatile part between SO_2 and SO_3 in the flue gas phase.

(a) Sulfur Remaining in the Ash

It is obvious that fuels such as gas and oil which leave relatively little or no ash may be assumed to burn in such a manner that essentially all of the original sulfur is converted to SO_2 and SO_3 in the combustion. In the case of solid fuels, however, the problem is more complicated. Johnstone[5] has shown that from 10 to 30 per cent of the original sulfur in the fuel remains in the ash. Others[2] have shown that the fraction of sulfur remaining in the ash is often less than 10 per cent. It is apparent that there is no definite fraction which can be taken to represent this quantity exactly. It seems that different fuels may yield different results. The actual quantities involved are small, however, and no serious error will be introduced into the final estimation by making any reasonable assumption of this quantity based upon the facts available. In the present paper it has been assumed that 20 per cent of the sulfur in a solid natural fuel remains in the ash. In the case of coke most of the volatile sulfur has been eliminated from the original natural fuel. It was therefore assumed that at least 5 per cent of the sulfur remaining in this fuel would remain in the ash.

(b) The SO_2/SO_3 Ratio

Some time ago the authors determined the dew points of the combustion products for a number of mixtures of a manufactured gas and air[12]. The partial pressures of the $H_2O + H_2SO_4$ (H_2O) in these mixtures was calculated from the combustion data. As has already been shown, the SO_3 content of the flue gas mixtures can be estimated from the data by the use of Fig. 3 (presented in Part I). These data are summarized on

EDITOR'S NOTE: Footnote figures refer to a list of references which may be found at the end of this article.

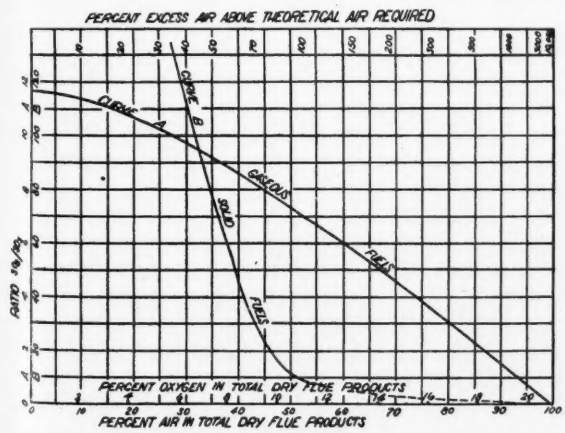

Fig. 4. Curves showing the SO_2/SO_3 ratios in flue gas for both solid and gaseous fuels

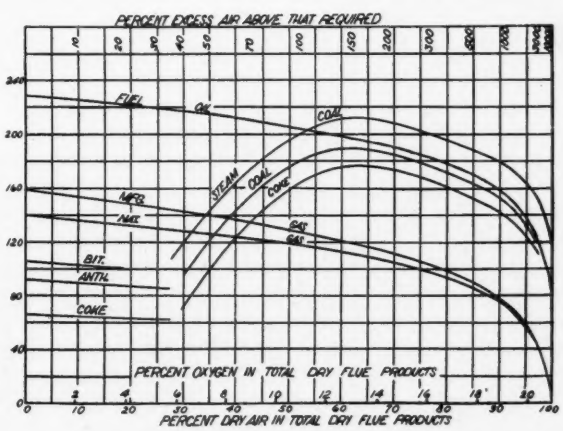

Fig. 5. Calculated dew points for industrial fuels

Table IV. The partition of the total sulfur between SO_3 and SO_2 was found, and the ratio of SO_2 to SO_3 was calculated.

It will be noted that the ratio of SO_2 to SO_3 decreased as the amount of excess air was increased. Johnstone[6] discussed several factors relative to the oxidation of sulfur in coals to SO_2 and SO_3 in the flue gases. He pointed out that the amount of SO_3 attainable at any temperature depends upon the concentrations of SO_2 and of O_2. As the temperature decreases, however, the proportion of SO_3 should increase according to the equilibrium constants.

Samples taken from various locations in the flue lines did not show that this was the case, and Johnstone believed that the velocity of the gases through the flue connections was such that equilibrium in the $SO_2 + O_2$ reaction was not obtained. Other factors mentioned by Johnstone include the catalytic effect of certain dusts and of metallic salts such as $FeSO_4$ in the flue linings. The volatilization of SO_3 directly from sulfates in the original fuel was also considered.

In view of these facts it may be somewhat doubtful whether the ratios of SO_2/SO_3 would hold under all conditions in the combustion of a gas with air. The probable instability of the equilibrium conditions within the flues may account for the fact that more definite experimental data relative to the analyses of such flue gas mixtures are not available. The few results that are available, however, seem to indicate that the ratios as calculated on Table III will hold reasonably well for gases and possibly for liquid fuels[5, 7]. These ratios are indicated by Curve A in Fig. 4.

The situation with respect to the formation of sulfur trioxide in the combustion products from solid fuels is just as uncertain as that in the case of the combustion products from gaseous fuels, perhaps even more so. Johnstone[5] has presented a rather complete analysis of the corrosion found in the flue connections in a number of steam generating plants which were using fuels which ranged in sulfur content from 2 to more than 5 per cent. These data include the rather complete analyses of the fuels and of the flue products. A summary of the averaged data is given in Table V. It is indicated here that the dew points of the flue products from such fuels range from 200 deg. F. to possibly 500 deg. F. depending upon the sulfur content of the fuel to a certain extent. But in the case of Plant J, the sulfur content of the fuel was high and yet the corrosion was light. This shows that the manner of combustion is an important factor.

The analysis of the flue products from the steam plants shows that, as the excess air was increased, the ratio of SO_2 to SO_3 in the flue products decreased. The total sulfur determined in the case of Plant C was only 49 per cent as compared with about 80 per cent for the other plants. Even the SO_2/SO_3 ratio for this plant falls into line if a suitable correction is made for this apparently low result. It might be noted that in this case only two samples were taken as compared with many more in the other plants.

Table IV. Calculation of the SO_3 Concentration in the Combustion Products of Manufactured City Gas from the Known Dew Points [12]

% Air in Dry Flue Products	Detd. Dew Point °F.	Cu. Ft. Dry Flue Prod. Per Cu. Ft. Gas	Pmm H_2O Hg	Per Cent of Dry Flue Products: Total as SO_2	SO_3 Fig. 3	SO_2 by Difference	Ratio SO_2/SO_3
0	159	4.35	154	.00350	.00028	.00322	11.5
20	149	5.44	130	.00280	.00024	.00256	10.7
40	137	7.25	103	.00210	.00022	.00188	8.5
60	122	10.88	74	.00140	.00020	.00120	6.0
80	98	21.75	42	.00070	.00018	.00052	2.9
90	79	43.50	24	.00035	.00016	.00019	1.2

Note: 9 grains sulfur per 100 cu. ft. gas.

Table V. Fuels and Flue Gases in Steam Generating Plants

			Corrosion in Plant: Economizer Gas Temp., °F.		Economizer Water Temp.		Preheater Gas Temp., °F.		Preheater Air Temp., °F.
Plant	Fuel	% S by Wt. in Fuel	In	Out	In	Out	In	Out	Out
A	Coal	4.45	580	370	300	390	370	290	220
C	Coal	3.18	585	340	200	350	340	240	175
H	Coal	2.1	650	420	240	330	420	235	300
I	Gas & Oil	high	770	510	285	375	510	370	370
J	Pulv. Coal	4.67	1050	350	205	425	350	230	380

A—General corrosion in economizer and preheater, replacement in 2-3 yr.
C—Severe corrosion in economizer and preheater, starts at bottom of economizer.
H—Slight corrosion, only 5 tubes replaced in 3 yr.
I—Extreme corrosion back as far as economizer in 3 mo.
J—Little corrosion even in spite of large changes due to shut down nights.

Fuel in Plant I was natural gas, fuel oil, acid tars, soda bottoms, neutral sludge, wax tailings, pulv. petroleum coke, acid lubricating sludge, and any combination of any or all.

Analysis of Flue Products

Plant	No. of Samples Analyzed	Detd. Analysis, % by Volume: CO_2	SO_2	SO_3	Total SO_2+SO_3	Ratio SO_2/SO_3	Calculated Total SO_2+SO_3	% of that found by Anal.	% Excess Air Calc. from CO_2
A	23	10.7	.279	.0082	.287	34	.336	85	68
C	2	11.4	.100	.0028	.103	36	.212	49	57
H	6	12.5	.121	.0015	.122	81	.156	78	49
I	23	10.5	.097	.0133	.110	7	...	..	70
J	8	13.6	.413	.0032	.416	129	.419	99	36

The analysis of the flue products shows that, as the excess air was increased, the ratio of SO_2 to SO_3 in the flue products decreased. The total sulfur determined in the case of Plant C was only 49 per cent as compared with about 80 per cent for the other plants. Even the SO_2/SO_3 ratio for this plant falls into line if a suitable correction is made for this apparently low result. It might be noted that in this case only two samples were taken as compared with many more in the other plants.

Plant	Fuel	% Excess Air in Flue Products	Ratio SO_2/SO_3
A	Coal	68	34
C	Coal	57	50
H	Coal	49	81
J	Coal (Pulv.)	36	129
I	Gas & Oil	70	7

In the case of Plant I in which natural gas and oil were used as fuel, the SO_2/SO_3 ratio falls well into line with the ratios previously indicated for gaseous and liquid fuels.

The ratios just indicated for solid fuels are represented by Curve B on Fig. 4. By the use of the two curves on Fig. 4, it is possible to estimate the SO_2/SO_3 ratios and consequently the SO_3 content of the flue products from solid, liquid, and gaseous fuels, when the original sulfur content of the fuel is known, due allowance being made for the sulfur remaining behind in the ash if any.

The data on Tables VI and VII show the results for such calculations for a few typical fuels. The data from Table VII were plotted as shown in Fig. 5, and the smooth curves show the general deviation in the true dew points which may be expected for the combustion products of various types of fuels

Table VI. Theoretical Combustion of Typical Fuels

Analysis	Mfd. Gas %	Nat. Gas %	Analysis	Fuel Oil %	Bit. Coal %	Anthr. Coal %	Coke %
H_2	45.99	....	Carbon	85.30	77.85	80.37	86.45
CO	11.79	....	Hydrogen	11.90	4.96	2.71	0.91
CH_4	25.26	95.23	Sulfur	0.50	1.00	0.60	0.80
C_2H_4	2.06	....	Oxygen	1.00	5.87	3.08	0.65
C_2H_6	....	2.65	Nitrogen	0.30	1.54	0.79	1.25
C_3H_8	....	0.39	Moisture	1.00	2.44	3.33	0.50
C_6H_6	1.38	....	Ash	....	6.34	9.12	9.44
CO_2	2.85	....					
O_2	0.20	....					
N_2	8.74	....					
H_2O	1.73	1.73					
Sulfur	.015	.0007					
Sp. Gr. at 60° F.	.471	.575					
B.t.u. per cu. ft.	539	1047	B.t.u. per lb.	19,000	13,898	13,351	12,836
Combustion	Cu.ft. per Cu.ft.Gas			Cu. ft. per pound of Fuel			
Air Req. (dry)	4.559	9.600		181.4	136.5	131.5	133.9
Total Products							
Dry basis	4.211	8.601		170.3	132.7	129.4	133.3
Wet basis	5.315	10.675		194.6	143.7	136.3	136.4
Analysis of Products of Combustion % by volume (dry basis)							
CO_2	12.42	11.82		15.80	18.51	19.59	20.45
N_2	87.59	88.18		84.16	81.40	80.35	79.48
S as SO_2	0.0036	0.00008		0.035	0.089	0.055	0.071
% by volume (wet basis)							
H_2O	20.77	19.43		12.49	7.71	5.11	2.24
Theo. Dew Pt. °F.	142°	140°		123°	106°	94°	67°

with varying amounts of excess air.

A rather peculiar situation develops in the case of the solid fuels, for which the high SO_2/SO_3 ratios noted in the study of Johnstone's data were applied to obtain the estimated SO_3 necessary for the calculated dew points. It is found that the SO_3 concentration increases as the excess air is increased. The calculated true dew points, therefore, start low and increase as the excess air is increased. The true dew point reaches a maximum with about 100 to 200 per cent excess air, and from this point on the curve follows those for the gas and fuel oil.

The situation just reviewed is possible in view of the usual reducing atmosphere which exists over a solid fuel fire bed with low excess air. Conditions for the formation of SO_3 would not be favorable. As the excess air is increased, however, such a condition would alter, and SO_3 could be formed in increasing amounts as the excess air increased up to a certain degree, after which it would be expected to decrease as shown on Fig. 5.

In the case of the combustion of gases and probably liquids, the air is fed into and intimately mixed with the gas or vapor before combustion. This procedure aids in the more rapid and perfect burning of the fuel, which in turn favors the formation of SO_3 in the presence of lower excess air. Thus the amount of SO_3 in the flue products of these fuels is larger, and the true dew points higher, even though the amount of sulfur in the fuels themselves may actually be smaller than in the case of the coals. As the excess air increases, the dew points of the higher sulfur coals rapidly increase and exceed those of the low sulfur gases.

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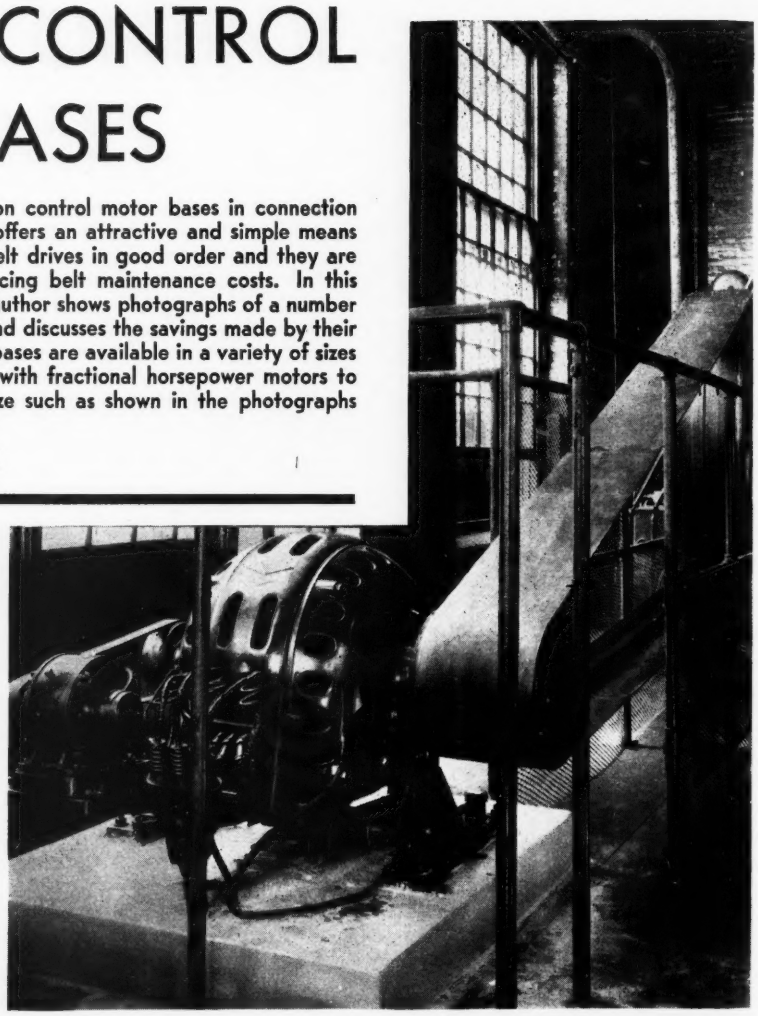
Table VII. Summary of Dew Point Data for Some Fuels with Excess Air

Fuel	% Excess Air	% by Volume SO_3	P mm. H_2O	Dew Point H_2O only	Dew Point Est. from Chart
Nat.	0	.000007	148	140	140
Gas	50	less	104	126	126
	100	less	81	117	117
	200	less	57	105	105
	500	less	32	87	87
Mfd.	0	.00028	158	142	160
Gas	50	.00023	112	130	140
	100	.00022	88	120	128
	200	.00019	62	108	113
	500	.00017	35	89	90
Fuel	0	.0028	95	123	230
Oil	50	.0023	67	111	212
	100	.0022	52	102	200
	200	.0019	37	91	190
	500	.0016	22	75	172
Bit.	0	none	58	106	106
Steam	50	.0006	41	95	118
Coal	100	.0031	33	87	172
	200	.0038	24	78	176
	500	.0029	15	64	156
Anthr.	0	none	39	93	93
Coal	50	.0004	28	83	120
	100	.0020	23	77	180
	200	.0024	17	69	180
	500	.0018	12	57	164
Coke	0	none	17	67	67
	50	.0004	14	61	100
	100	.0020	12	56	164
	200	.0026	10	52	174
	500	.0019	8	46	154

TENSION CONTROL MOTOR BASES

The use of tension control motor bases in connection with belt drives offers an attractive and simple means of maintaining belt drives in good order and they are effective in reducing belt maintenance costs. In this short article the author shows photographs of a number of these drives and discusses the savings made by their use. These type bases are available in a variety of sizes from those used with fractional horsepower motors to those of large size such as shown in the photographs

By FRANCIS A. WESTBROOK



WHEN it comes to saving on the cost of belts, saving space and other advantages such as reduced maintenance costs, etc., it is often well worth while to look into the question as to what can be accomplished by using tension control motor bases. The plant where the drive shown in Fig. 2 is located almost cut the cost of the power transmission in half in this manner.

This drive originally operated on 21-ft. centers and the belt cost $209. When the existing belt wore

Fig. 1. (Right) A synchronous motor driving a triplex pump with both the driving motor and the exciter mounted on a tension control motor base

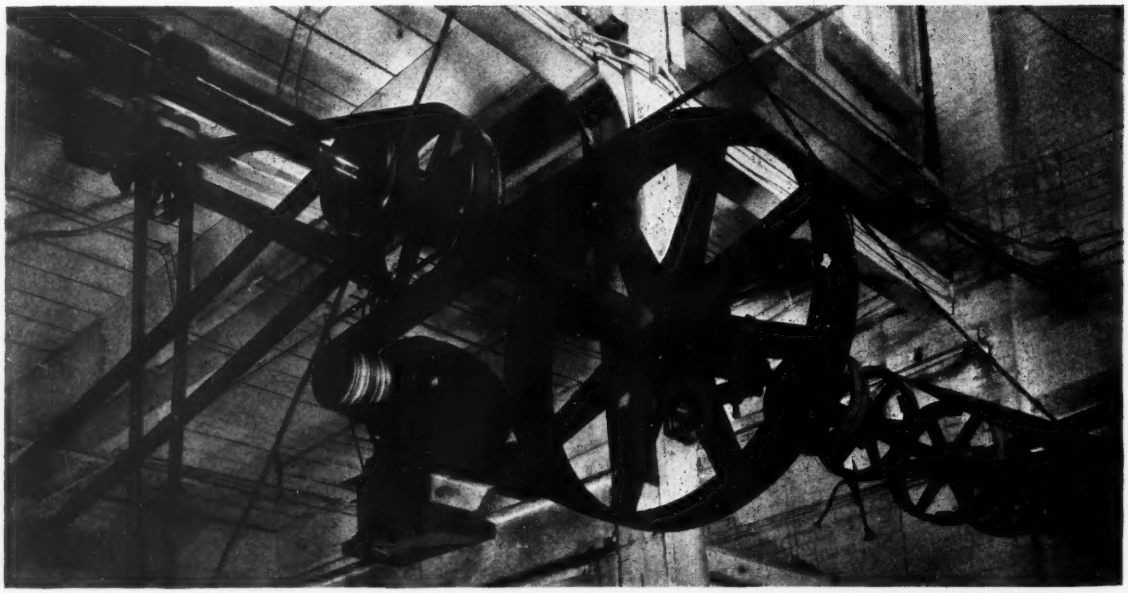


Fig. 2. The use of a tension control motor base in the case of this drive made possible a reduction in the length of the belt at a substantial savings in cost

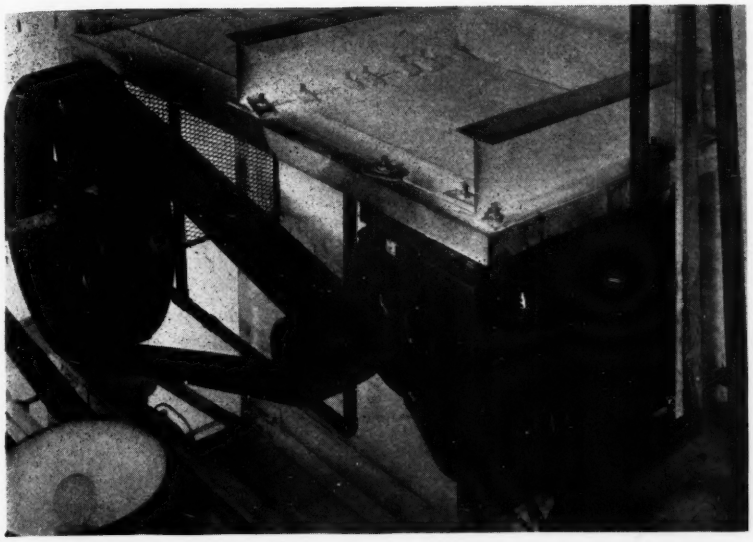


Fig. 3. A lineshaft drive with the motor mounted on a platform near the ceiling

out and had to be replaced it was decided to purchase a tension control motor base and place the motor on it. It was then possible to shorten the center distance to 4½ ft. The new short belt plus the tension control base cost less than $110. In addition to the saving in money there is also the very important saving in material which means so much at this time of great demand.

Motor Base Is Advantageous to Most Belt Drives

There are other advantages incident to the use of this type of motor base which apply to almost all belt drives. For instance, Fig. 1 shows a synchronous motor drive to a Triplex vertical pump which feeds an hydraulic accumulator furnishing power for several hydraulic presses. In this case it was not a question of shortening the center distance but more one of keeping the belt tight. Before the motor was mounted on its new base providing for the automatic tension control it was necessary to take up belt slack every week, and it was also necessary to shorten the belt at least twice a year.

The reason for the need of such frequent tightening was that the belt had to be kept tight on account of the large speed reduction, and the size of the drive. The motor in this case is a 115 hp. synchronous motor, with a speed of 900 r.p.m. The motor pulley is 14 in. in diameter by 17 in. wide while the driven pulley is 62 in. in diameter and has a 16 in. face. The distance between centers is 12 ft. and the leather belt is 12 in. wide.

For the 14 mo. since this has been converted to a tension control base drive it has not been necessary to take up the belt once. Obviously a lot of slipping has been eliminated with the corresponding wear on the expensive belt. Operation, is naturally, more smooth, much noise has been avoided and needless to say the belt maintenance has been practically done away with, or at least reduced to a small fraction of what it was formerly.

Another drive which has been greatly improved by the tension control base is shown in Fig. 3. It is a lineshaft drive with the motor mounted on a platform near the ceiling. This lineshaft had formerly been driven by a long center drive, the motor being located on the opposite side of the shaft. In that location the belt was so long that it cut off much of the light coming from the ceiling.

By rearranging the drive as shown in Fig. 3 and mounting the motor on the new base it was possible to shorten the center distance to 56 in. This also made it possible for the tight side of the belt to run on top. Thus the obstruction to the lighting was done away with and a portion of the former long belt was used for the short center drive. The reason why the drive could be so rearranged was that the new base made the short center distance possible.

These few examples serve to show the simplicity and the practicability of this type of belt tension control. The element of simplicity is one that should make them appeal to those who want to get away from complicated idler methods of control. These bases are available in a large variety of sizes and they are adaptable to motors varying from a fraction of a horsepower to large units such as shown in the accompanying illustrations. The photographs used in this article were supplied through the courtesy of The American Pulley Co.

IT PAYS TO OIL YOUR ELEVATOR ROPES

(*Continued from page* 63)

severe condition upon the new rope that is used as replacement. The reduced diameter of the old rope wore the drum grooves to such a narrow contour that the grooves cut by the old rope will not fit the new rope. The new rope will be too large for the old grooves and so will be pinched by the grooves, forced into an unnatural shape every time it passes around the drums and prevented at the very start from giving its normal service. Indeed such abuse is bound to take several years off the normal life of any new rope. Removing the drums, regrooving them, and mounting them back in place, is generally considered too expensive in both money and time.

Unlubricated Cable Grooves Drum

Although preformed wire rope has the characteristic of riding a sheave or drum straight—with little tendency to twist or rotate in the groove—yet here is photographic evidence that failure to lubricate a cable, even a preformed one, results in reduced diameter (due to core collapse) and subsequently worn drum grooves. The amount that the groove is gouged out is a function of time as well as rate. Since preformed rope generally is giving a much longer service life when used as a hoist cable, one of these ropes will abrade the drum for a much longer time than will an ordinary rope.

It must seem desirable, therefore, to keep the rope core lubricated to prevent shrinkage of the rope, whether the cable be preformed or nonpreformed.

If elevator hoist ropes are to give long life, the condition of the grooves in the traction drums is as important as the selection of the rope itself. Lubrication of the rope will help to keep those grooves in good condition.

To function properly, surface condensers must be kept in as nearly the conditions for which they were designed as possible, free of scale, slime and algae. Leaks due to corrosion, erosion, ill-fitting joints, defective packing and leaking relief valves need constant watching in order to maintain efficient condensation. Where and how to check for defects resulting from operation are outlined in this article

Surface Condenser Maintenance

By C. C. CUSTER

BY A MIRACULOUS series of changes, the modern large electric generating plant converts the heat bound up in coal into electric energy which may be distributed with small loss over a radius of hundreds of miles to serve mankind in homes, industries, and cities by performing work, supplying light and heat for innumerable purposes. Every step in the process is accompanied by an unavoidable loss, but by a study of these losses engineers have been able to devise energy saving equipment which is effective in bringing up the overall efficiency of a plant.

To be of greatest value, all plant equipment must function according to the principles of its design which necessitates occasional shut-downs for inspection and repair and, in well managed plants, the known troublesome conditions are catalogued and prevented from occurring wherever such is possible. In this article it is proposed to discuss the condensing equipment at which point the loss of energy is usually the highest in the heat cycle.

Scale and corrosion are the two most destructive agents in the maintenance of a heat power cycle; to these the engineer must give continuous attention. With a pressure of 800 lb. or more in the boiler and a high rate of combustion, any accumulation of scale in the boiler is a positive danger as well as a cause of reduced efficiency, so it is imperative that all feedwater should be free of scale-forming impurities. Not only this, but waters of a corrosive nature are destructive of boiler metal and present intolerable dangers.

Inasmuch as the condenser is an important part of the feedwater cycle, its condition must be maintained so that no leaks occur which will allow untreated cooling water to contaminate the condensate, nor is it permissible to allow the admission of air into the vacuum space and become entrained with the condensate changing it to a corrosive condition. Attention will therefore be given to condenser leaks, where they are likely to occur, how they may be detected and how they may be prevented or repaired.

Contamination Through Connections

Air and water leakage into the system may occur in the condenser itself or in the piping to it on the outside or somewhere in the auxiliaries. Consider some of these outside cases of contamination first. Air leaks have at various times been discovered at relief valves on the atmospheric relief lines. One dashpot plunger type of relief valve was found sometimes to fail to seat properly. Another time a multi-port type of relief valve, when it went noncondensing, had drawn in some dirt under one of the discs which prevented it from seating properly. These troubles are easily remedied by overhauling the relief valves.

Another source of constant but rather minute air leak into the vacuum is occasioned only rarely by porous castings in the exhaust line. We ran across several cases of this while building an ammonia refrigerating plant some 20 yr. ago. We were using pipe fittings cast by a small foundry and found that while the iron was impervious to water or steam, when used on the high-pressure ammonia line the ammonia would ooze out through the pores in the iron and on suction lines would put air into the system.

Air may also get into the vacuum lines at the flanged joints where changes of temperature may loosen the packing due to stresses at these joints. It now seems to be the practice with large units to connect the condenser to the bottom of the turbine casing with little intermediate piping. Sometimes an expansion joint is used next to the turbine, but if not, the condenser must be mounted on springs from below to keep stresses off the flanged joints.

In some modern plants the use of an atmospheric relief line is done away with entirely and they protect the system with "explosion heads" located at the lowest stage of the turbine. These operate in an emergency only, at about 10 lb. pressure, as they have an automatic trip throttle valve which cuts out the unit when the vacuum falls as low as 17 in. In this sort of hook-up when the turbine cuts out, the problem of relief to the boilers is thrown back onto the safety valve system on the boilers.

The most logical place, however, to find air infiltration is at the low-pressure side of the last turbine stage at the labyrinth packing. If this is a centrifugal water seal and not kept in working order it may be a source both for entrance of air and raw water. Though in some plants we understand they pipe the regular condensate water to these glands. If there is a condensate centrifugal

pump handling boiler feed of the kind that can leak air in along the shaft glands, these also should have inspection.

Condenser Leakage

Under commercial operation, the steam entering a surface condenser carries a certain amount of air or other waste gas, as for instance carbon dioxide. While the volume of air at the steam inlet is negligible in comparison with the volume of the steam, as the condensation of the steam proceeds through the tube bundle, the relative volume of air increases in ratio for while you can condense and liquefy the steam you cannot liquefy the air, the air is thus like a foreign body in the condenser interfering with efficiency and taking up valuable space and must be expelled. The best place to take out the air is at the coolest part of the condenser. The air is generally taken off near the bottom and to one side.

A surface condenser if properly designed is of itself an excellent deaerator. Some condensers are built with a small lower corner of the tube bank baffled off as an air cooling section with an air off-take. Thus some operators prefer to deaerate all the make-up in the main condenser, whereas others feel that the use of a separate deaerator or deaerating heater is preferable. For removing the air accumulating at the condenser, there was a time when the reciprocating air pump was used. In recent years steam jet air-ejector or evactor can be used to deaerate the feedwater heaters and evaporator in use in the plant.

In a plant that needs only 0.35 per cent of make-up water the size of evaporator capacity is small. Many of the largest condensers in use have a hotwell attached immediately below the condenser. This hotwell is sealed off from the shell by a short neck on the condenser discharging into a pot on the hot well forming a loop seal.

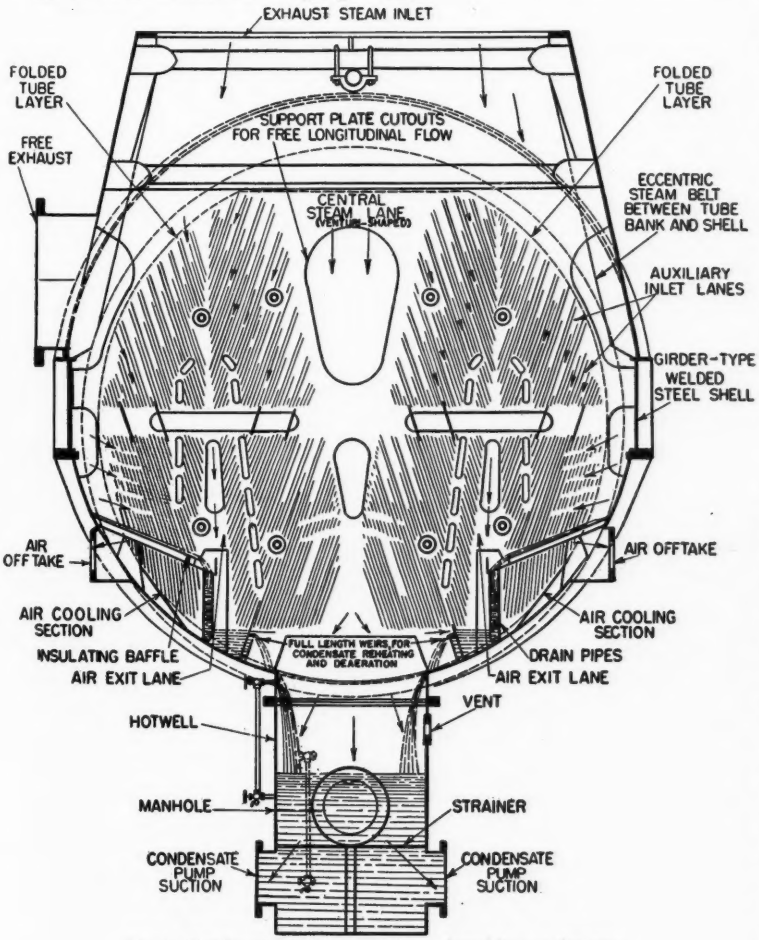


Fig. 1. Condensate draining system employed by one designer

Keeping the condenser tubing in condition is the most troublesome maintenance problem. The old fashioned type of condenser had both ends of the tubes secured in the headers with corset-string packing and retaining glands. The principal trouble was the loosening of the packing at the tube ends and raw water would leak from the circulating side into the condensate.

A surplus of water in the open hotwell indicated some leaky tube ends in the condenser. The contributing factor to this loosening of tubes in the headers was evidently the linear expansion of the tubes with changes of temperature; the cast-iron shell did not expand as fast as the tubes. This condition became aggravated whenever we had the misfortune to lose the vacuum and the condenser became overheated, after which we would generally find it necessary to overhaul and replace the tube packing. As there were some thousands of these tubes it was a tedious job to repack them. Later designs seek to obviate expansion stresses by some form of floating head.

In general, it may be said that while some operators prefer the use of the old method of corset lacing and fibre washers, it may be said that for small and medium sized condensers, the preference is to expand and bell the tubes at the inlet end of each pass and pack the boxes without ferrules. With larger units there is a tendency of design to expand the tubes at both ends, (with this type a floating head must be used) the inlet end being belled or flared to provide a smooth Venturi inlet.

No method of installing tubes is any better than the quality of workmanship expanded thereon. One simple method of taking care of differential expansion is by giving the tubes adequate upward bow at the center, intermediate support plates being raised to conform with the tube bowing, and unequally spaced to prevent tube vibration.

Other causes of tube failure may be mentioned, such as vibration; excessive wear at the tube inlets due to erosion, corrosion or both; dezincification; improper methods of installation; and inherent defects in the tubes themselves. In regard to the tubes there are now being furnished a wide variety of tube alloys, the

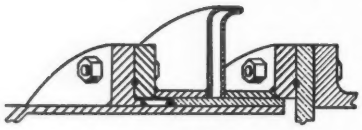


Fig. 2. Welded steel expansion joint designed to relieve expansion strains, prevent leaks and permit rolling tube ends into tube sheets

use of which depends on local conditions, especially on the quality of the circulating water used.

For fresh water installations, Muntz metal, admiralty metal, arsenical copper, or admiralty containing inhibitors such as arsenic, phosphorus, or antimony have been used. For salt water admiralty metal and more recently aluminum brass have been in favor. Cupric-nickel is more expensive but commonly used by the Navy.

There is a little difference of opinion about whether, when tubes are to be expanded in the heads, they should first be annealed near the end. Some say the annealing is not necessary if the tube fits the hole closely and the expanding is done carefully. It is, however, true that the use of floating heads does not entirely take care of tube leakage and there will be some tubes that split at the ends and some that break off just inside where they are expanded.

Looking over the repair sheet of a large condenser which had been operating for 5 yr. and contained 8000 tubes, we find that they had lost only about 100 tubes which is a small percentage—⅛ per cent—some by loosening in the roll but the majority from cracking off inside the tube sheet. They had absolutely no scale on the steam side of the tubes and they kept the water side of the tubes clean by injecting chlorine gas every 4 to 6 hr. to prevent algae growth. They never found it necessary to shoot plugs through the condenser to clean it. They, however, had steam erosion on some of the top tubes. This is not corrosion but is erosion. It is caused by particles of condensate in the steam entering the condenser at a velocity of probably more than 300 ft. per sec. The remedy for this is to install solid rods in place of the tubes in the top row or plug the tubes in the affected area and allow them to be a protection for the ones below.

Some condenser designers try to avoid this by baffles, either longitudinal or vertical, and by trying to get a better distribution of the steam to the tubes by rearranging the spacing of the rows of tubes or entirely surrounding the tube bank with steam space. By good design the entering exhaust steam should not contain more than 13 per cent moisture. Superheating of steam makes it behave more like a perfect gas and cuts down the erosion that sometimes occurs in the steam turbine buckets, but of course, it is impracticable to exhaust steam to the condenser while it is still superheated.

The presence of an air leak into the condenser under operating conditions may be detected if we have an air-flow meter in connection with our evactor or steam-jet ejector. If we have a raw-water leakage into our condensing system it is possible to detect it quickly by the meter which measures the amount of our make-up water. Another suggested method is the testing of the condensate for electrical conductivity.

One plant reports that the Winkler test for dissolved oxygen does not help much as an indication on account of the small leakage of air not eliminated by the deaerating equipment. When using sea water as circulating water it is standard practice to test the boiler water on each shift by use of a salinometer.

It is of course a self-evident fact that it is desirable to get as far as possible a good supply of condensing water. This is frequently possible by locating the power plant on the bank of a lake. When located on the bank of a river we find the river water may be contaminated with sewage promoting algae growth or a slime on the tubes which interferes with the heat transmitting ability. In the fall of the year the river may bring down a lot of leaves to choke up the rack or lodge in the water boxes of the condenser. Also slush or floating ice may clog up the intake.

It is customary in well designed plants to have revolving screens at the intake to eliminate minnows and leaves and a rack or "grizzly" of coarser screen ahead of the intake traveling screens to take care of the larger floating debris. Now and then we hear of "anchor ice" coming down the river in such quantity as to suddenly block shut the condensing intake. This occurs only during the first hard freeze of winter when the crystals of needle ice form in the river building out from shore and finally break loose and come down stream in bulk, land on the rack and shut it up tight, leaving the forebay empty of water.

After the first skin of ice is formed on the river it protects the water underneath from the formation of further anchor ice. In the writer's experience we were shut down one morning in early winter at 2 a. m. by anchor ice which suddenly came down on us and left us with no cooling water.

It is also necessary to have the intake equipped with headgates so we can close them and inspect and repair the circulating water centrifugal pumps in the forebay. In one plant we know about they closed the head gates for repair, and when they went back to open them again they found they were frozen fast in place and they had considerable trouble in getting them open again.

High efficiency in operation of condensers is secured by both modern design and intelligent operation on the part of the plant personnel trusted to keep the plant "up to bogie" in the operation.

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800 CYCLE MOTOR COOLS RADIOS

A TINY MOTOR weighing less than 2 lb., developed by Westinghouse engineers for war purposes, drives a small blower to keep radio transmitters cool. Power is supplied to these particular radio sets at a frequency of 800 cycles and the same source must serve the blower motor as well. Requiring 20 watts of power, the motor runs at a speed of 6700 r.p.m. and must be able to start at 30 deg. below zero; it must be specially resistant to moisture, and must be able to withstand rough handling. Based on a design made in 1936, the motor is rather remarkable. It will operate on frequencies ranging from 600 to 1400 cycles, with some speed variation. The capacitor may be changed to permit use on either 60 or 120 v. By changing only the winding—all other physical parts remaining the same—the motor can be used on 400 cycle current. Contrary to what one might expect, Westinghouse experts say the motor operates a little faster and more efficiently on 400 cycles.

SPRAY CANOPY For Roof Cooling

Solar heat penetrating roof of blackout type buildings is effectively prevented by roof spray systems and thus reduces necessary capacity of the air conditioning equipment

By A. B. TAPPEN, President, Water Cooling Corporation

ONE VERY serious objection to the blackout type of industrial building produced by the war situation is that the great expanse of flat roof absorbs and transmits the solar heat into the building to such an extent that the operating efficiency of the personnel within the building is seriously affected. This objection to blackout buildings which is almost non-existent in England, owing to different climatic conditions, can of course be taken care of by an air cooling system, but the size of such a system for a building covering say 500,000 sq. ft. is costly and requires large amounts of refrigerating machinery thereby putting an additional strain on an already overloaded industry.

Some authorities having recognized the handicaps of roof heat absorption, tried to take care of it by making a roof level and carrying 2 in. of water on top. While this helps, it is, under the best conditions, less than half as efficient as a spray canopy. It is inefficient in a prolonged hot spell, as the evaporative area of the surface water is not sufficient to prevent the water heating up. Other objections to such a roof are that in case of heavy rainfall it does not drain properly and furthermore there are possibilities of the stagnant water producing mosquitoes.

Quite often in the past, where it was desired to re-cool water for Diesel engines or other fairly high temperature work, a spray cooling pond was placed on a factory roof, thereby getting good exposure for the re-cooling of the water. An attendant benefit was that the space below such pond did not become heated by the sun. For such work, nozzles were designed to throw 25 to 50 g.p.m. of water 8 to 10 ft. in the air at about 7 lb. pressure.

The fall of water from these large nozzles gave considerable wash on the roof, with the result that a special basin of steel, wood or concrete had to be provided. Furthermore owing to the height of the water spray, a louvre fence had to be built around the pond to prevent the spray from becoming a nuisance. Many of these installations have been made and they have given satisfactory results for what they were intended, i.e., re-cooling of industrial water.

Roof Cooling

Some years ago the writer had a factory condition where the temperatures in the summer afternoons became excessive, and therefore we took up the question of using small nozzles for sprinkling the roof and keeping the temperature down. The primary point of design of a spray canopy to prevent the solar heat from entering a building is almost directly opposite to that of a spray pond where in order to reduce construction expense and save space it was customary to load these ponds to about 1¼ gal. of water per sq. ft. per min. The governing feature of a spray canopy is to have a system which will give the best practical covering with the least amount of water, keeping in mind the fact that the system should operate 10 hr. a day for months at a time. (War conditions may make it advisable to operate 24 hr. per day.) It should put no additional wear on the roof, and the spray loss must be kept at a minimum.

The result was that the nozzles were designed with removable caps for easy cleaning to give a coverage of about 15 ft. diameter with less than 1 g.p.m. when spraying at 7 lb. pressure, height of spray being not over 30 in., thus keeping the spray below the usual building parapet.

The question of having a roof spray system exposed to the prevailing wind, which is so important to the cooling pond where the aim is to remove the greatest possible number of B.t.u.'s from the water, is of little importance with a roof cooling system where the aim is to have the solar heat used up in evaporation before it enters the building.

In 1939 the writer was called

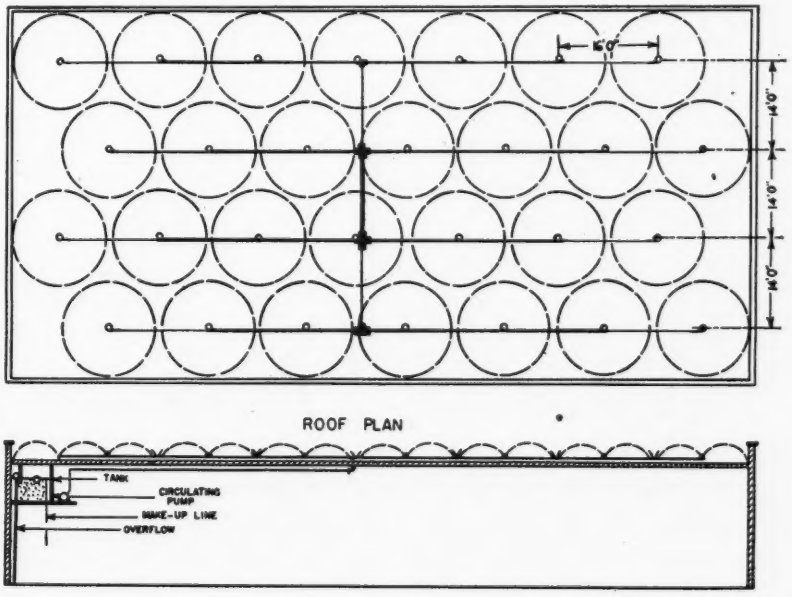

Fig. 1. Plan and elevation of spray nozzle roof cooling system

to lay out a spray canopy to cover the roof of a new 400,000 sq. ft. blackout building on Long Island, for one of our prominent aeronautical companies. The air conditioning engineers, who are the leaders in their field, figured that a proper canopy of spray over such a blackout building would reduce the refrigeration tonnage required from 1080 without a roof spray canopy to 800 tons with a proper system. Figuring the refrigeration equipment at $200 per ton showed a saving (280 tons at $200 per ton) of $56,000 against the estimated cost of the roof spray system of $20,000—actual cost was less. Maintenance is practically nil and operating cost is slight, as the system operates with waste water from the condensers or cooling coils at a nozzle pressure of 7 lb.

Other important facts were that such a spray canopy increases the life of the roof covering as it stops excessive expansion and contraction of roofing material and also stops the loss of the more volatile oils which are driven off from an asphalt by the hot sun.

While the primary object of a spray canopy over a roof is to protect a building against solar heat, nevertheless if sufficient water is used, say ¾ gal. per nozzle or more (adequate not only to take care of the evaporative effect of the sun, but also to keep the roof wet) it provides positive protection against incendiary bombs and flying sparks. With such a system in operation 24 hr. a day, there is no waiting for the fire wardens "to get on the job."

As this was the first really large roof protection system to be put in service in this country, details were studied very carefully, with the idea that the system should be capable for operating continuously for 4 or 5 mo. without shutdown for cleaning or repairs.

Piping and Nozzles

Brass piping being out for the duration, it was decided to use nothing less than ⅜-in. steel pipe. Also to keep the number of penetrations of the roof, such as pipe connections, bolt holes, nails, etc., to a minimum.

With this particular building there was from 1.1 to 1⅓ g.p.m. of water per nozzle available, and therefore we designed special nozzles to handle these amounts of water as follows:

Nozzle Pressure	Height of Spray	Diameter of Coverage at Nozzle Level
4 lb.	1 ft. 6 in.	11 ft.
5 lb.	1 ft. 9 in.	12 ft. 6 in.
6 lb.	2 ft.	14 ft.
7 lb.	2 ft. 3 in.	15 ft.

The above figures are average. Spread does not include spatter.

These nozzles were connected to the feed pipes through adjustable ball joints of brass, thus making it possible to have the connecting tees slanted down to give complete drainage. At the same time it makes it possible for an operator to change the plane of spray where desired without breaking into the pipe system (only tool required is a screw driver). Rather than use the usual form of pipe supports, which would have had to be screwed or bolted to the roof, thus breaking through the roof covering, a special form of redwood support was designed resting on top of the roofing with wedges which permit easy adjustment of pipe lines for proper drainage.

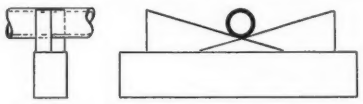

Fig. 2. Double wedge arrangement of pipe support makes easy adjustment of pipe level without fastening to roof

The result of this installation during the summer of 1941 was so satisfactory that when Plant No. 2 was started in the fall, we were instructed to prepare a layout for the new building which was installed before the building was completed. Both plants gave satisfactory results during the past summer.

In this case the idea of putting all distribution piping above the roof was accepted (on the first job the main distribution pipes were kept under the roof with the result that they had to be covered to avoid trouble from condensation with resultant drip on machinery or personnel during the humid weather). Condensation and resultant dripping which take place above the roof is of no importance.

Another advantage of having all main supply lines above the roof is that the number of roof penetrations is reduced, and furthermore with the operating valves above the roof, a man when making adjustments can see exactly what he is doing. Care should be taken in laying out the roof to see that water drains off promptly, rather than laying in pools, where it may actually heat up from the sun, or possibly breed mosquitoes.

The result of these first two installations has been so satisfactory that the third large plant addition now under way is to have a roof canopy similar to Plant No. 2.

The cooling effect within the building is not due to the water temperature but is due to the solar heat being absorbed by the evaporation of the spray before such solar heat enters the roof. In a non-aircooled one-story building the afternoon temperature will be 10 to 15 deg. cooler with a proper spray canopy than without.

Out on Long Island there is plenty of underground water, so the question of saving water did not enter into the problem, but if water is costly or scarce or there is any question of sewer capacity, the solution is to catch the water at the eaves of the building and re-circulate it.

WAS YOU THERE?

One of the most potent weapons which the Nazis introduced to modern warfare is the deliberate propagation of RUMOR. It is a weapon against which Americans must steel themselves with unceasing vigilance, for all the tanks, guns and ships in the world cannot bar its entry into our homes.

The conflict of ensuing rumors served well the aim of the Nazis to confuse and befuddle the French, and what semblance of unity the French possessed soon disappeared. Even before the Germans had entered France, the people heard that their government had fled; that Russia and the United States had declared war on Germany; that Great Britain had surrendered.

It is worth noting how at least one Russian guerrilla commander solved this problem in his own unit. Severe punishment was meted out to anyone who said "I hear that . . . . . ." or "I understand that . . . . . ." Unless the man could say "I, myself, saw . . . . . ." he was to say nothing.

The next time someone tells you that he has it "on good authority" and so forth, just ask him, "Was you there, Charlie?"

Automatic Production of TUBE-ICE

BY B. F. KUBAUGH
Henry Vogt Machine Co.
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In January, 1941, a brief description was presented on these pages of a new type of ice machine—an automatic tube-ice machine developed by the Henry Vogt Machine Co. Few details of the machine were available at the time, but the principles of the unit were outlined in sufficient detail so that the operation of the machine could be understood. Since that time the author delivered a paper on this process of ice making at the fall meeting of the American Society of Mechanical Engineers and it is from this paper that the further details of the development in this article have been abstracted

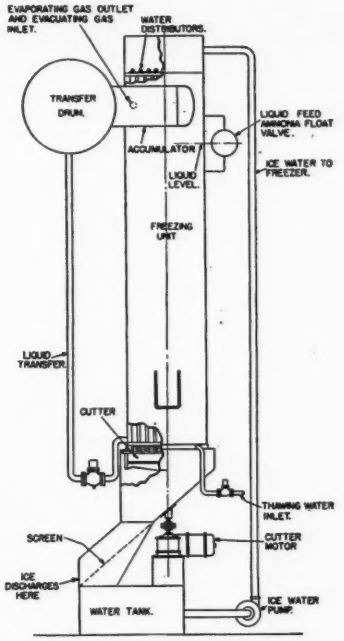


Fig. 1. Diagram of the automatic tube-ice machine

IN ORDER to overcome the drawbacks and limitations of some of the older systems of making ice, a new method of producing hard clear ice at once in small pieces of almost any desired size has been developed in the form of the tube-ice machine described in the following paragraphs.

Referring to Fig. 1 this tube-ice machine consists of a number of tubes of any diameter or length set on end vertically and enclosed in a shell, much in the manner of the well-known vertical tubular open ended condenser, commonly called the shell and tube condenser. This equipment is mounted over an inclined chute, consisting partly of solid metal and partly of screen or perforated material.

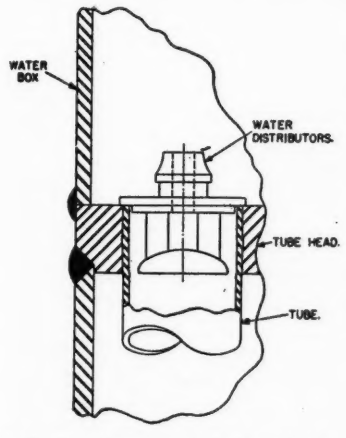


Fig. 2. Distributor provided with each tube to spread the water

Below the chute is a water tank from which the water to be frozen is withdrawn by a pump and delivered to the top of the vessel where it is distributed evenly to the tubes. Each tube is provided with a metal distributor, Fig. 2, which causes the water passing through its orifice to be projected against the inner surface of the tube to which it clings in its descent. This circulation of the water provides the agitation which is required to produce clear ice.

Beneath the vessel and above the chute, is a rotating cutter, Fig. 4, which not only nicks and breaks the ice as it drops out of the tubes, but it also measures the length of the pieces before they are cut. Beneath the lower tube head (see Fig. 3) is situated at a very short distance a shear plate which is attached to the tube plate by a ring, thus forming a closed chamber comprising an auxiliary thawing chamber through which a very small quantity of moderately warm water (85 to 90 deg. F.) is discharged at the desired moment to thaw the bottom tube head. This shear plate also relieves the tube head of any shock due to the cutting operation; the cutter lies just beneath the shear plate.

The tubes protrude only a short distance below the tube head and are extended to and through the shear plate by means of copper ferrules, thus forming the thawing chamber referred to. The vessel itself is filled with the refrigerant, usually ammonia, to a required height determined by a float-controlled liquid feed valve. Near the top of the vessel is a horizontal transfer drum into which the refrigerant from the freezer is periodically discharged and from which it is expelled and returned to the freezer.

Freezing Operations

At the beginning of the freezing operations a timing mechanism which controls all of the functions, is started. On single vessel installations the timer also controls the water pump, starting and stopping it periodically. On multiple-vessel installations the water pump runs continuously and the timer merely controls the admission of the water alternately to the two or more vessels comprising the unit. With the water in circulation, the timer opens the suction valve and the liquid feed, and the freezing proceeds for a period previously determined for the suction or evaporating pressure employed, and for the thickness or kind of ice desired.

At the termination of the freezing period the timer shuts off the suction gas, the liquid feed,

the water flow, then admits high-pressure evacuating gas from the condenser, which displaces or removes the liquid refrigerant from the freezer into the transfer drum, and at the same time thaws the ice from the tubes. A few seconds after the beginning of the evacuation, the timer starts rotating the cutter, and admits warm water to the thawing chamber. Simultaneously with the removal of the liquid, the ice tubes drop by gravity onto the rotating cutter and is delivered to the chute in pieces of the desired size.

All the events described take place in a matter of seconds; the entire operation from the moment when the suction valve is closed to the moment when the last piece of ice has dropped onto the chutes occupies hardly more than 2 min. regardless of the size of the freezing vessel.

Determining the Freezing Capacity

The water which is circulated and which drops from the tubes returns to the pumping tank through the perforated portion of the chute. The ice, discharged, passes over the perforated region to other points of delivery, such as a chute to storage room below or to a horizontal conveyor or an elevating conveyor.

The thickness of the ice from a very thin shell to a solid cylinder is controlled by the length of the freezing period which in turn is regulated by a simple speed control on the small timer motor. The freezing period varies from as little as 10 min. for shell (crushed) ice at low evaporating pressure (around 15 lb.) to about 37 min. for solid ice at high evaporating pressure (around 30 lb.). Where crushed ice is desired the ice cylinders are relatively thin (about ½ in.), and short, so that the cutter, which for such a purpose has a rather blunt edge, breaks them up into small pieces.

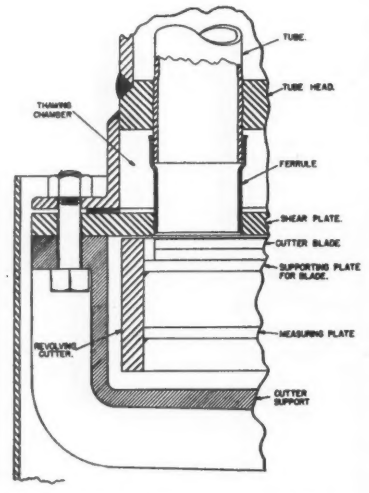


Fig. 3. Section through lower part of machine, showing shear plate auxiliary thawing chamber and revolving cutter

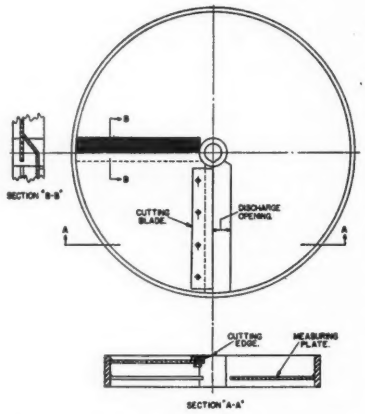


Fig. 4. Details of the rotating cutter which breaks up the ice cylinder as it leaves the tube

The question will be asked, no doubt: "What effect has the freezing of the solid ice on the tubes?" The answer is that there is no discernible effect. The tubes are not expanded by the freezing action because the water is not confined in any manner. Analogous to this is the freezing of ice in the conventional can which produces no distortion of the can. The solid ice produced as a standard is a cylinder approximately 1¾ in. diam. and 2½ in. long. Other lengths may be furnished by merely fixing the measuring plate of the cutter at the required distance. In fact, an adjustable cutter is available, whereby the length can be altered from time to time, requiring only a few minutes for the purpose.

The number of freezing vessels required in any given case is determined by the capacity desired, the maximum diameter of freezer advisable, the evaporating pressure, and the kind of ice (solid or crushed) preferred; also, by the maximum number of vessels deemed desirable. All capacities up to that of the largest single freezer require, obviously, only one vessel. As indicating the flexibility of the tube-ice system, single freezer units cover capacities from a fraction of 1 to 29 t. in "solid ice" and to 40 t. in crushed ice.

When the required quantity of ice exceeds the capacity of a single maximum-diameter freezer, then the number and diameter of freezers is determined from the freezing period selected and the harvesting or cutting period. Such consideration leads to the adoption, for large capacities, say of 150 to 200 t. of the system wherein evacuation takes place from shell to shell rather than from shell to transfer drum, which has structural and cost advantages unnecessary to enlarge upon in this paper.

The timing mechanism consists of several cams of plastic material mounted on a horizontal shaft driven by a very small motor. Each cam controls a small electrical switch which opens or closes a circuit to operate a magnet-controlled valve, one for each function of the system, viz., liquid feeding, freezing, evacuating (and thawing), and final thawing. Cutting and water circulation are also so controlled through proper devices.

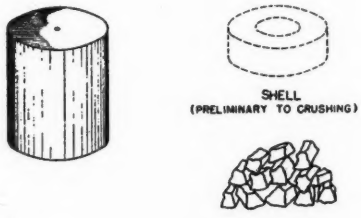


Fig. 5. Solid and hollow ice cylinders and the final product in crushed form

The motor on the timer is so connected that it may be accelerated or reduced in speed to control the freezing period only; all other functions proceed at a previously fixed speed. Each function is indicated by a small colored light on the control panel, making observation extremely easy. The control panel also mounts a pressure gage and magnetic starters for the cutter motor and water pump, as well as small selector switches built into the timer circuits, by means of which any function may be operated manually at will, if desired or necessary. Magnetic starters for other purposes, such as the conveyors previously described, may also be mounted and operated simultaneously with the cutting operation.

Figure 5 illustrates several ice cylinders, both solid and hollow. There is no fixed length for the

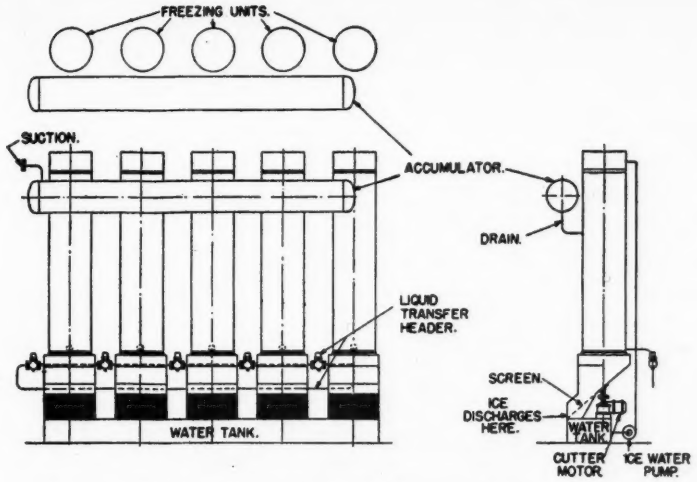


Fig. 6. Automatic tube-ice machine showing the ice evacuating system and a side and front elevation of the entire assembly

"solid ice," which can be made to suit any peculiar conditions or preferences. The hollow cylinder is the form best suited to the production of crushed ice.

Refrigeration and Power Requirements

Regarding refrigeration and power required to produce 1 ton of tube ice, it is evident that the weight of metal, heated and subsequently cooled in the evacuating and thawing operations, is quite large in proportion to the ice made, but it should be understood that such heating constitutes merely a transfer of heat from one part of the system to another. This also produces changes in temperature and state of the gas used for evacuating and thawing, as well as changes in temperature only of the small quantity of water used for thawing, whereby some of the evacuating gas is condensed and the thawing water enters the system at a temperature lower than that of the water from the original source.

Consideration of these factors shows that the refrigerating capacity is lower than that required in the conventional can plant, where 6 per cent of the ice frozen is washed away to the sewer, about 25 per cent lost in sawing (cubes), and where the heat of compression of the low pressure air used for agitation must be absorbed by the refrigerating machine.

In the tube-ice system nothing leaves the apparatus but the ice to be used. The tube-ice machine may be attached to an existing refrigerating plant or it may be installed independently with its own "high side" compressor, condenser, receiver, etc.

The space occupied is of interest. A 10-t. single-vessel freezing unit occupies a space approximately 6 by 7 ft.; a 40-t. single-vessel unit, 8 by 9 ft.; a 65-t. two-vessel unit, 8 by 12 ft.; a 200-t. five-vessel unit, 9 by 30 ft. or 18 by 20 ft.

SUPPLEMENTAL COMPENSATION PLANS

RISING living costs are reviving interest in plans to adjust wages automatically in accordance with fluctuations in the cost of living, according to a survey by the Management Research Div. of The Conference Board and several well known companies have recently adopted such plans.

These plans are simple in principle, but those now in operation vary a great deal with respect to certain provisions. As a general rule, they provide for an adjustment of wages whenever some designated index of the cost of living advances or declines a specified number of points. The usual method is to increase or decrease wages whenever the cost of living index rises or falls five points.

Many plans, however, provide that these adjustments may be made only at specified intervals, such as quarterly or semi-annually. To protect the employe from the consequences of an unforeseen sharp decline in the cost of living, the plans ordinarily stipulate that wages are not to be reduced below the scale in force on the date of the adoption of the plan; and to protect the employer from the consequences of an unexpectedly large increase in the cost of living, some plans provide that if the index rises more than a certain amount, such as 10 per cent, the plans will be subject to review.

One of the main objectives of employers in establishing these plans has been to provide a method whereby the problem of wage increases in a period of rising living costs may be dealt with systematically, so as to reduce or eliminate demands for wage increases. Some employers, however, have sought merely to protect their employes against higher living costs.

Although these objectives have been largely attained by the companies who have such plans now in active operation, past experience has revealed defects which may tend to deter employers from adopting them more widely. Labor leaders have often opposed them on the ground that labor should strive for higher living standards, and not be content with protecting present standards. Recently there seems to have been some change in this attitude, presumably because union contracts are usually made for one year and the inclusion of cost-of-living adjustments at least guards against loss of purchasing power in the event of a sudden, sharp rise in the cost of living.

The attitude of employes toward the plans now in operation has thus far been favorable, but this is no doubt largely because the adjustments have been upward. Experience has shown that despite all efforts to make it clear that compensation for higher living costs is supplementary, employes usually look upon it as part of their regular wages. When the time comes to reduce the supplementary compensation because of a decline in the cost of living, the employe's attitude is often much the same as it would be toward a reduction in basic wages. Another disadvantage is that some employes have difficulty in understanding the cost of living index and how it operates. The question is often raised whether the cost of living index accurately measures changes in living costs.

From the point of view of employers, the greatest disadvantage is that plans of this kind, unless they include adequate safeguards, commit the companies which adopt them to uncertain contingent liabilities in the form of higher future labor costs.

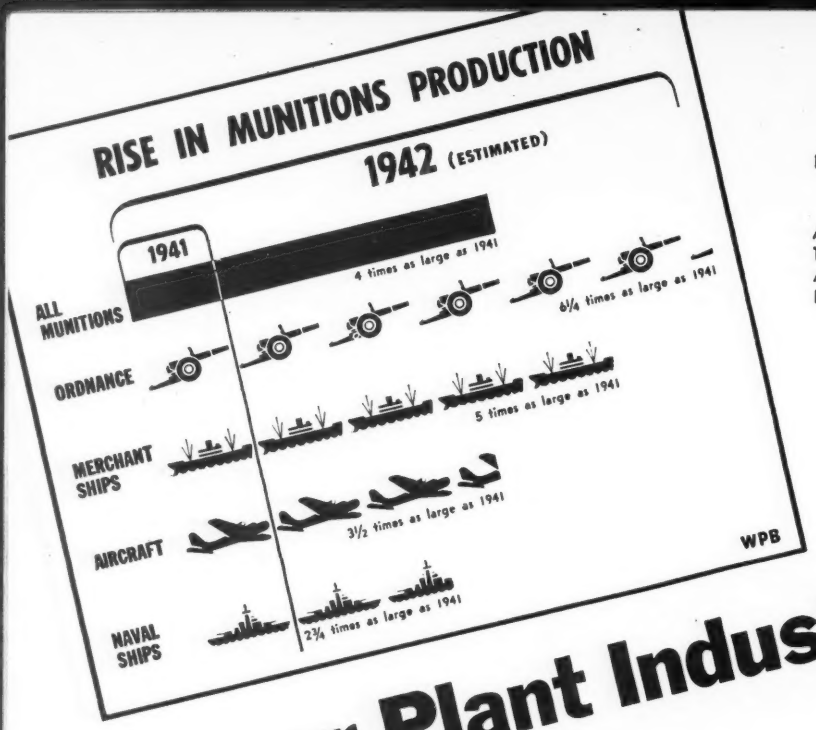


Fig. 1. Chart showing increase in 1942 munitions production over that of 1941

War Output (OWI data—Dec. 7, 1942)

Airplanes	49,000
Tanks and self-propelled artillery	32,000
Anti-aircraft guns (20 mm. and over)	17,000
Merchant ships (dead weight tons)	8,200,000

Power Plant Industry Meets All

A brief review of the past year's developments in the power and electrical industry under the impact of total war. Despite a volume of industrial production four times that of 1941, the entire power field has successfully met all requirements. Available steam and power generating equipment capacity has been stretched to carry the load; transportation and fuel problems have been surmounted; substitutes have been employed for scarce or strategic materials; new products developed and ingenuity displayed in maintenance work. There will be no power shortage in 1943, at the peak of the war

THE FIRST big job has been done—and done well. American industry is in production for war. And in preparing for this task, the power engineers of the Nation have done a great job. In the face of problems whose magnitude could scarcely have been imagined in time of peace, they have kept rolling the great plants of the expanding armament industry that have produced four times the munitions in 1942 that they did in 1941. At the same time, civilian electrical requirements have been covered without recourse to curtailment or rationing. The margin of reserves for the country as a whole has been increased substantially above that of last year.

Conversion of existing facilities along with progressive construction of new munitions plants has freed for the production of war materials much of the peacetime and civilian load. Largely as a result of these characteristics, says the Edison Electric Institute, utility sales of industrial power increased only 16 per cent in 1942, notwithstanding the increase of almost 400 per cent in war expenditures and production of munitions. These facts are shown graphically in Figs. 1 and 2. Industrial power sales rose to 88,000,000,000 kw-hr. in 1942, representing 56 per cent of utility sales as against 54 per cent in 1941. At the same time and despite dim-outs, daylight saving and other factors, other uses of electricity have increased 11 per cent.

Output Increases 12 Per Cent

Output of electricity for public use in 1942 is given by the E. E. I. as 188,000,000,000 kw-hr., by the Federal Power Commission as over 183,000,000,000 kw-hr., an increase in both cases of approximately 12 per cent over 1941. Generating capacity at year's end was 47,000,000 kw., the year's net increase being 2,720,000 kw., of which 1,655,000 kw. was in steam, 1,011,000 kw. in hydro and 54,000 kw. in internal combustion engines. For all public supply stations, the non-coincident peak load for December, 1942, was about 37,000,000 kw., which is 10,000,000 kw. below the installed capacity; the December, 1941, margin was 9,000,000 kw. For Class I utilities, the peak is 8 per cent below their own estimate of a year ago and 20 per cent below that of F. P. C., due to daylight-saving time, failure of war loads to increase as rapidly as expected, and other factors.

About 2,800,000 kw. of scheduled capacity was ordered cancelled by the WPB in 1942, affecting mostly units scheduled for 1944 and 1945. Total net increase in generating capacity scheduled for 1943 is 3,384,000 kw.; for 1944 it is 521,000 kw. and for 1945 about 195,000, a total of 4,000,000 kw. during the next 3 yr.

In view of existing trends, present reserve margins and scheduled additions, no power shortage is on the horizon for 1943, when America's war effort is expected to be at the peak, according to the E. E. I.

In 1942, fuels produced 123,300,000,000 kw-hr., an increase of 7 per cent, and water power produced 63,200,000,000 kw-hr., an increase of 23 per cent over 1941. The hydro gain reflects the breaking of droughts as well as the additional capacity installed. Utilities have enlarged their coal storage to 4 mo. supply instead of the usual 80 days, thus leveling seasonal coal demands and easing the transport burden. (See POWER PLANT ENGINEERING, July, 1942.)

War Demands in 1942

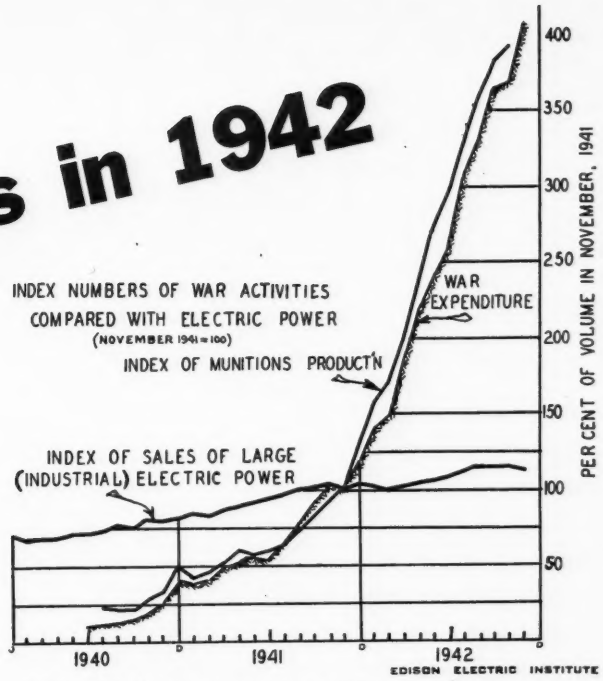


Fig. 2. Chart showing how power industry carried the 1942 war load

In addition to utility generating capacity, many manufacturing plants and mines produce their own power. During 1942, E. E. I. estimates they generated 46,500,000,000 kw-hr. If this is added to utility production, the grand total for the United States is approximately 235,000,000,000 kw-hr., greater than that of all Axis-dominated areas and equal to two-fifths of the total world production.

In industrial power plants as well as in central stations, one of the principal problems has been in materials—getting along with what they could get, substituting one material for another, redesigning equipment, modifying methods. All plants have given some attention to blackout precautions and procedures for operation in case of air raids. (See POWER PLANT ENGINEERING, Nov., 1942, p. 58.) In some of the blackout tests held in various parts of the country, all the difficulties anticipated did not arise for the utilities. What they might be in a real raid is a different story, although all possible precautions have been taken against gas, incendiary and demolition bomb attacks, as well as sabotage. (See POWER PLANT ENGINEERING, Jan., 1943, p. 74.)

Preparations have been made by WPB, the utilities and industrial plants to integrate all power supplies when and if necessary, a regional system having been worked out for this purpose. Since the utility industry is already fully interconnected and a large number of industrial plants in peacetime were also interconnected with utility lines, the techniques of doing this are established and little difficulty is anticipated. However, it has not yet been widely practiced, for balancing of loads and cutting off of non-essential civilian load as provided by WPB will solve many problems.

Although there has been considerable interest, in the Eastern part of the country, in conversion of oil-burning plants to coal burning, the problem, while difficult in some cases, is not insoluble. Many engineers took proper steps in time. Plants converting to war work could usually get equipment on priorities. Some plants were already set up to burn coal or oil for peacetime economic reasons. And coal is still the base fuel for American industry. Hence the principal outcry on conversion comes from commercial and domestic users.

Need for substituting for or eliminating steel so it can go into munitions has hastened the trend

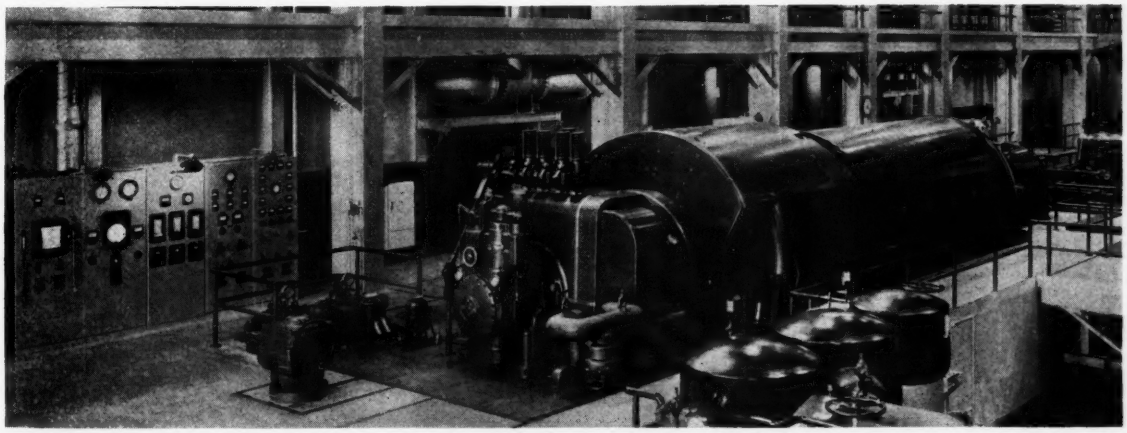


Fig. 3. G-E 52,000-kw., 3600 r.p.m., tandem-compound turbine-generator set installed in 1942

Fig. 4. Textile machinery plant converted to manufacture of G-E mechanical drive turbines for synthetic rubber and high-octane gas industries

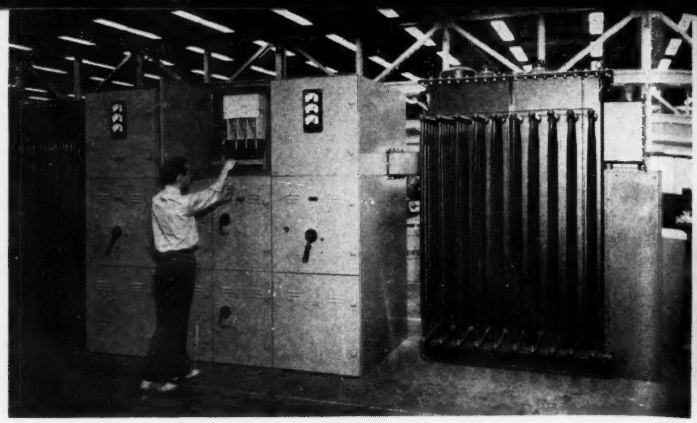


Fig. 5. G-E unit substation with draw-out air circuit breakers and self-cooled 3-phase, 122-kv-a., 13.8 delta to 440-v., 60-cycle pyranol transformer, installed in a building

toward semi-outdoor power plants. A dozen or so important steam plants of this type are now in operation (see POWER PLANT ENGINEERING, Oct., 1942, p. 62; Jan., 1943, p. 50) and several others are projected or under construction. Wood-pole transmission-line construction and wood substation structures have saved considerable steel.

Operating data on the single installation of high-pressure forced-circulation boiler, issued this year, shows that it has so far proved successful. Publication of detailed data on the various mercury vapor installations reveals that the Kearny installation is operating successfully at a heat rate of 9200 B.t.u. per kw-hr. (Trans. A.S.M.E., Oct., 1942, Vol. 64, No. 7.)

Principal power plant, industrial, electrical, and manufacturing problems and trends are shown by the following reports.

General Electric Co.'s 1942 Developments

GENERATING EQUIPMENT. Conspicuous among large turbine-generator units delivered or nearing completion were five 85,000-kw. cross-compound machines; three 80,000-kw. single-cylinder units; and a 100,000-kw. cross-compound equipment with quadruple-flow construction for the low-pressure unit. A 75,000-kw. single-cylinder machine was shipped, and two others were under construction; and there were also two single-cylinder units of 60,000 and three of 50,000-kw. each.

By the end of the year there were six large tandem-compound high-pressure condensing units operating at 3600 r.p.m., all with hydrogen-cooled generators. Unique among high-pressure, non-condensing machines was a 20,000-kw. unit pioneering with a forced circulation boiler; it has steam conditions of 1800 lb., 950 deg. F. total temperature, and 400-lb. exhaust, with the steam resuperheated to 750 deg. F. before going to a low-pressure turbine.

Among waterwheel generators delivered were a 54,000-kv-a., 450 r.p.m. unit, three 33,333-kv-a., 94.7 r.p.m. machines, and two 40,000-kv-a. units. Approaching completion were an 82,500-kv-a. and two 60,000-kv-a. generators.

TRANSFORMERS. Application of forced cooling made it possible to reduce the active material in a transformer proper by approximately 20 per cent, and material used for cooling equipment by about 85 per cent, as compared with a self-cooled transformer of the same rating. A new design of standard indoor-dry-type transformers not only saved critical materials but reduced size and weight and improved appearance.

Fig. 6. This 138-kv. compressed air circuit breaker, capacity 1,500,000 kv-a., is largest Westinghouse unit of its type

Fig. 7. Automatic control and instrument panels for 2 boilers supplying a 60,000-kw. turbine generator unit put in operation in 1942

Fig. 8. Grand Coulee Dam of U. S. Bureau of Reclamation went into operation in 1942, with three 108,000 kw. units, three more similar units to come and a total of 18 units proposed for completed plant

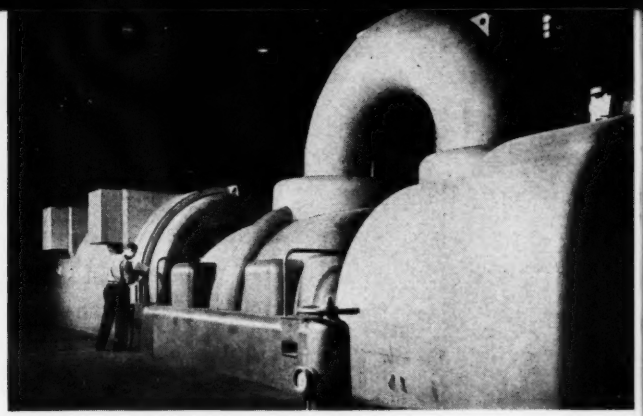


Fig. 9. One of the 60,000-kw., 3600-r.p.m. turbine-generator units placed in operation in 1942, with hydrogen-cooled generator

For the steel industry there was being built a 20,000-kw. electronic frequency changer, for interchanging 44-kv., 25 cycle and 66-kv., 60 cycle power in either direction. Grid control will regulate the power flow automatically, compensating for frequency and voltage fluctuations. The operator will be able to reverse the power flow without any switching in the power circuit.

SWITCHGEAR. In line with the general movement throughout the electrical industry to conserve materials, the small wiring and control connections in switchgear were made with AWG 14 wire instead of No. 12. For low-current circuit interconnections, bars were made of steel; and in metal-enclosed switchgear the barriers not essentially required were eliminated. To conserve structural steel members, wood was substituted for steel structures in a number of outdoor stations.

The largest single installation of 34,500-v. metal-enclosed switchgear so far built was designed with 14 cubicles. A 5000 amp. 15,000-v., air-blast circuit breaker in a metal-enclosed cubicle represented the highest current rating ever built in a high-voltage breaker.

Distribution Equipment

Gas-filled cable was extended to 69,000 v. with pressures of the order of 35 psi., and to higher voltages with pressures in the order of 200 psi. The first uses a reinforced or high-strength lead sheath, and the second employs a steel pipe. Low-pressure gas-filled cable previously was feasible to 34,500 v.

Improved power distribution systems, incorporating load-center unit substations for secondary distribution systems, were prominently featured during the year.

Direct current power for general purpose applications, in blocks of 150 to 500 kw. and mostly at 250 v., was called for during the year by a large number of war industries. With the country's facilities for producing rotating conversion equipment so heavily loaded, the sealed ignitron substation-type rectifier proved admirably suited for most such installations.

MOTORS. Tri-Clad construction was extended during the year to totally-enclosed motors, of non-ventilated, smooth-surfaced design; and features of Tri-Clad design were reflected in motors as large as 1250 hp. at 720 r.p.m. Dust-explosion-proof motors were made available for use in aluminum, magnesium, and other hazardous metal-dust locations; and another line was produced for coal dust, coke dust, and carbon-black conditions.

For refinery, ordnance plant, and similar locations, sizes of squirrel-cage motors for (gas) explosion-proof conditions were extended to 600 hp.; a line of (gas) explosion-

Fig. 10. View on exhauster fan floor in boiler house of one of 1942 installations. Two boilers are controlled from panels shown in Fig. 7

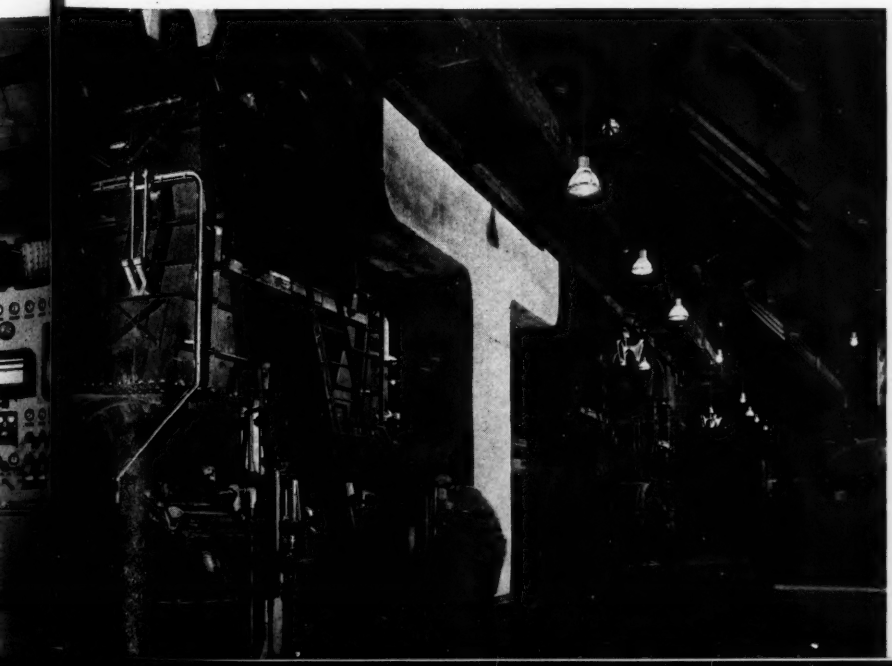
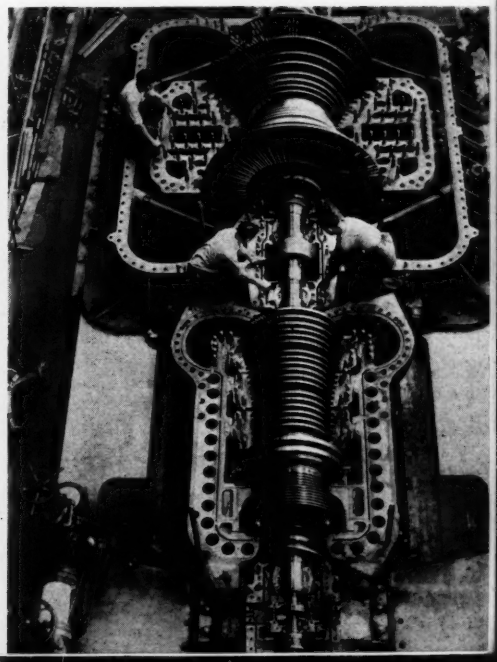


Fig. 11. Hydrogen-cooled 50,000-kw., 3600-r.p.m. tandem-compound Westinghouse turbine generator during assembly



proof wound-rotor motors was made in sizes up to 600 hp.; and a line of vertical hollow shaft squirrel-cage (gas) explosion-proof motors with non-reverse ratchets was developed.

New ordnance, synthetic rubber and similar plants required many vertical synchronous motors for pump applications, for which a line of high-speed hollow-shaft motors was developed. Direct-current motors were in great demand for battery-operated flying or mobile battle equipment. The precision control and protection of the amplidyne generator further stimulated direct current applications.

Both electrical and mechanical improvements were made in Thymo-trol equipment (see page 64) and this electronic motor-control system given numerous new applications.

Industrial Power Units

For expanded production of aluminum, required rectifier capacity was supplied for nearly a quarter-million kilowatts of pot lines, in widely distributed plants. Additional capacity totaling more than a quarter-million kilowatts was nearing completion.

The necessary rectifiers, furnace transformers, amplidyne control, or other electrical equipment were also supplied to various plants for increasing the production of magnesium, zinc, and chlorine, all greatly needed in the war effort.

The largest motors built so far for oil-pipeline service, rated 1500-hp. each, were supplied for the 24-in. ("Big Inch") pipeline between Texas and Illinois, and additional motors were under construction for the extension of the line from Illinois to the Atlantic seaboard.

Steam turbines, as high as 35,000 kw. capacity, were much in demand for synthetic rubber factories, which require large amounts of process steam. The turbines will supply steam at relatively high pressure to a large number of mechanical-drive turbines which will discharge the steam into the process, at the same time driving pumps. Some of the generated power will be absorbed by nearby utilities. Not only turbines but also special motors, power house and switchgear equipment, distribution switchgear, unit substations, and many cycle timers were also required for the new plants.

Several million kilowatt-hours per month are being saved in airplane engine tests by a power-recovery system developed by General Electric in collaboration with Pratt & Whitney Aircraft. Testing under the new method produces large amounts of electric power which previously were wasted. A generator, instead of propeller, is used as the load while the engine is being tested. (See POWER PLANT ENGINEERING, July, 1942.)

Electrical Measurements

For thin, compact instruments there was produced a new element of the permanent-magnet, moving-coil type featuring "internal pivot" construction. The new miniature instruments are only 63 per cent as deep as previous models. Glass vee jewels manufactured by a new process were put into mass production, breaking a bottleneck developed when importation of sapphire jewels from Switzerland was cut off. Among the year's new electrical measuring instruments were a hook-on ammeter to measure direct current in a conductor without cutting the conductor; a high-sensitivity, self-contained frequency meter (for 60 cycles) with a precision of one part in 12,000; several modifications, for special applications, of the high-speed photoelectric recorder; a light-beam alternating current wattmeter to measure a small amount of power at low power factor, for testing very small motors; a sturdy galvanometer with higher sensitivity than previous self-contained units; a redesigned general-purpose oscillograph.

A large number of 1,000,000-v. industrial X-ray equipments were delivered or were in production for a wide variety of industries, to insure quality and to speed up production of very heavy metal objects.

Westinghouse Elec. & Mfg. Co Developments

With ideas as ammunition and engineering "know-how" for weapons, the Westinghouse Elec. & Mfg. Co. has waged industrial war on the Axis. A glance at this company's accomplishments in 1942 shows more than $500,000,000 worth of war materials turned out by Westinghouse plants from coast to coast. An average of one full carload of war goods was shipped every 10 min.—day and night.

War equipment produced has included electrical devices to aim guns, operate airplane and tank equipment, drive ships and send military messages through the air. From its production lines rolled millions of shells, bomb fuses, turbines and gears for ships, armor piercing shot and plastic liners for army helmets.

Modern assembly line methods enabled the Westinghouse Elevator Co. to turn out record-breaking quantities of gun mounts. American 1.1 guns have been produced at a saving to the Navy of more than $10,000,000 in cost and 4,400,000 man-hours of work. Before the company tackled the job in the summer of 1940, each gun mount required 8500 man-hours of labor and cost about $27,000. New manufacturing techniques cut the work time to 2100 man-hours and the cost to about $12,000. By May, 1942, the company was turning out nearly 40 per cent more mounts each month than its contract called for.

Engineers Had to Work Fast

Typical of the speed at which engineers worked was the development of an electronic method of fusing electrolytic tin plate, a task that once required big furnaces or vats of hot oil. The electronic method uses only one-third as much war-scarce tin as the old method of dipping the steel strip into vats of molten tin. An induction heating process using 200,000-cycle a-c fuses the tin into a shiny surface.

To light new factories turning out war products, Westinghouse designed and manufactured during 1942 enough tubular-shaped fluorescent lamps to illuminate a plant 200 mi. long and a mile wide. The company also supplied lighting equipment for more than 100 air fields, Army airports and bases.

To create more electric power for aluminum plants and other war industries, Westinghouse was working during the year on three 108,000-kw. waterwheel generators —largest in the world. This brings to nine the number of these waterwheel generators the company has contracted to build for Grand Coulee Dam. Three have been completed and installed, three now are under construction and the final three probably will be built after the war.

To speed the production of synthetic rubber, Westinghouse is building more than $3,000,000 worth of power line protective devices, turbines, transformers, explosion-proof motors and other apparatus for 24 new synthetic rubber plants.

(*Continued on page* 112)

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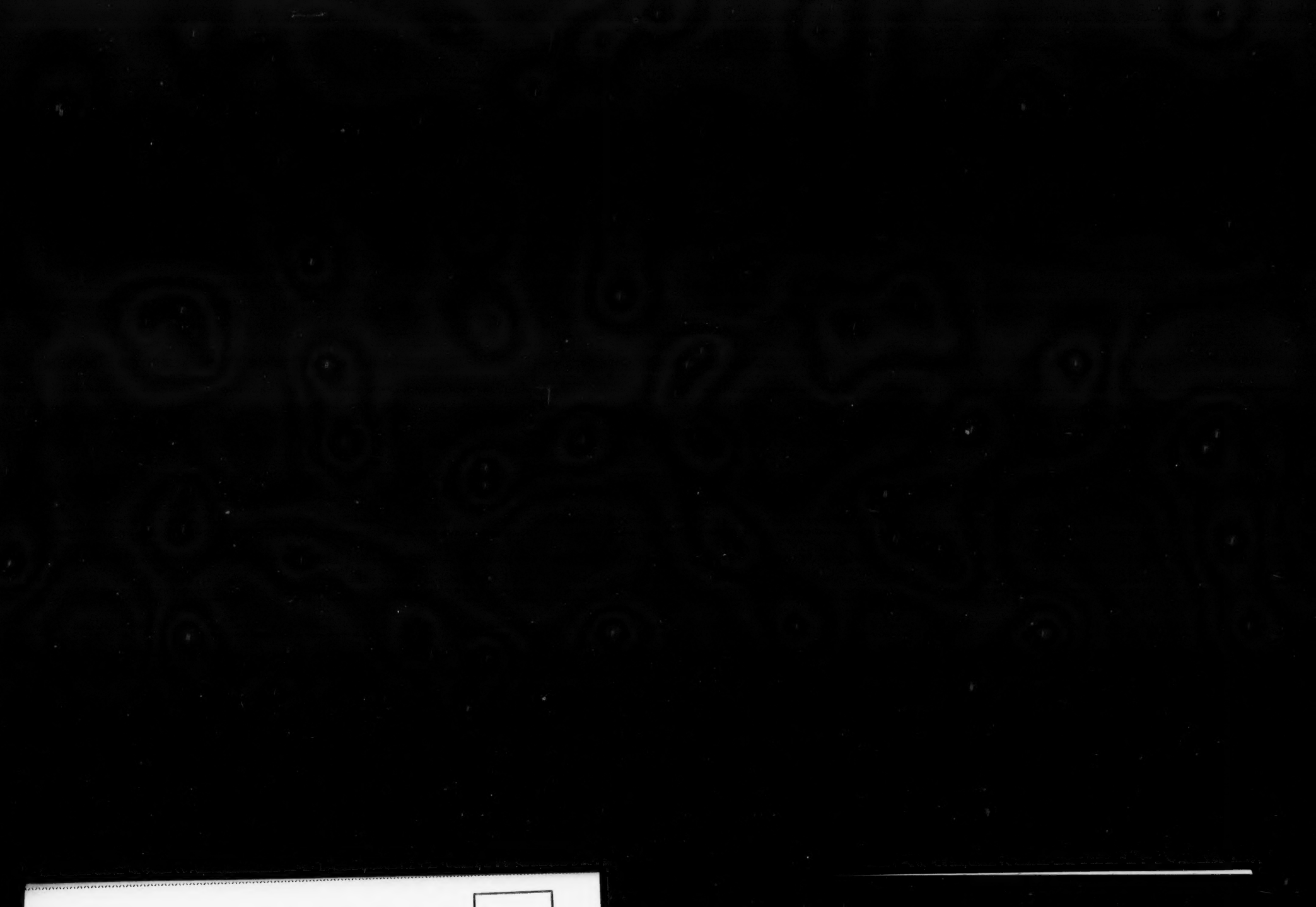

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

'TAIN'T FUNNY

What some engineers are already up against and what an increasing number are going to face as the war continues is reflected in a short article which recently appeared in the General Radio Experimenter and credited to a journal in the printing trade.

A purchasing agent writing to his regular sources of supply requesting new catalogs, price lists and other data is said to have received the following replies:

"We are glad to advise the illustrations in our catalog are still O.K., only we have discontinued most of the items. If we sent you the whole list of what we are not making, our catalog would be useless."

"Forget the prices. Also forget the descriptions. By the time you get this letter we do not know ourselves how or what we will be making the stuff out of."

"Thank you for your note indicating you still have one of our complete catalogs. Please return it at once. You ought to see the prices we are receiving here for our waste paper."

"After reading your inquiry we are afraid you are thinking of sending us an order. It looks suspicious to us. Nevertheless, we will gladly meet you halfway by showing you how to calculate costs, if you will promise to send the order to someone else."

"The only part of that catalog we are still certain about is the line that says, 'Established in 1885.' All other information and prices have been withdrawn."

"We will answer your question if you will first answer one for us: What do you want with a price on things we do not have and cannot get?"

Fortunately conditions are not yet that bad in our field although certain things are scarce, some are impossible to obtain and many others require a high priority rating. A glance at the new catalog sections will show there is as yet no shortage of catalogs. However, it behooves every engineer to determine and order what he actually needs, remembering that the order may not be filled for some time—also that purchase of unneeded equipment and material may deprive someone else of its use in a place where it may be vitally needed.

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago, Ill.

Chief Electrician—The Engineering Wizard

By DAN GUTLEBEN
Chief Engineer, Pennsylvania Sugar Co.

AN ENGINEER must possess and develop ingenuity so as to keep alive and justify his profession. Anybody who has inherited a barrel of money can perform an engineering job even without the exercise of much brain, but "us engineers" can accomplish with $1 what a bungler does for $10. By this definition our chief electrician is an Engineer. We call him the Wizard. In his office in his shop he has an electric clock. While he sits there at noon cogitating, and eating his lunch, his crew is disporting itself in the shop, spinning yarns and eating sandwiches. Now if the Wizard had $10 and were an ordinary bungler, he would buy an electric bell to call the craft from refreshment to labor when the clock strikes one. The Wizard in fact has the ten spot but he is a thrifty sort of person. After lunch he recovers his "repossessed" paper lunch bag, inflates it and, pop! the boys get the signal that it is time to go to work.

"Mike" Speed of Eagle-Globe-Royal Indemnity Co. and Herman Dost, chief electrician of Pennsylvania Sugar Co. on a periodic "sleuthing expedition" to detect faulty insulation

On the other hand an engineer must also develop a reasonable I.Q. and avoid thoughtless and precipitate action. The Wizard has a tom cat who resembles a tiger. When he was born in the electric shop 5 yr. ago the boys baptized him "Magee". Magee has a friendly character. He is quick on the trigger. One day he was taking a siesta on the window sill of the electric shop which was then located on the 7th floor. A pigeon flew past the window. Magee's quick eye caught a glimpse of the pigeon and under a reflexive impulse he made a leap for the bird. He landed 7 stories below and disappeared. A few days later the boys were about to chant a solemn requiem for the repose of Magee's soul when suddenly he returned, a trifle lopsided but nevertheless able to assert his rights. Magee fortunately was equipped with the kind of structure that could stand the consequence of a thoughtless act. An engineer is built on a more awkward pattern, but God has compensated for this deficiency by giving him some machinery with which to think.

Electrical Disturbance

During the installation of the main cables connecting No. 3 generator to the switch board in 1919, two of the cables became crossed. Al Chapman was at the switchboard. At the other end of the tunnel that terminated at the generator was Al Bradley. The Wizard was within earshot of both ends but could not see them. He turned towards Al Chapman and hollered, "Al, interchange those cables." Both Als heard the order and obeyed. The bell indicated that they were still wrong and the Wizard hollered, "change them back." Both Als obeyed the order again! The Wizard couldn't figure it out! That night the boys went home to sleep over it. The next day Al Bradley staid home leaving only one Al on the job and the cables were straightened out. The mystery however was not clarified till 3 days later when the two Als sat down to compare notes.

The "Megger" Test

Every Saturday before and after our week-end cleaning the Wizard applies our "Megger" Tester to all of our important generating equipment. Usually nothing happens, except that some figures are added to our records of insulation resistance.

Then one day the Megger test indicates that somewhere there is a leak. Maybe an innocent wire has rubbed against a jittery frame and like the surgeon's X-ray the Megger test detects the condition and a failure is forestalled.

With our insulation resistance records, we further watch any progressive weakening of the "arteries" and having warning that permits us to make repairs at convenient times, rather than tie up all or part of our plant. Newly wound motors and wiring installations also have to submit to the Megger test and not infrequently a blow-up is thereby averted.

A maintenance gang without a Megger tester would be like a surgeon without an X-ray machine.

Ten Commandments of Motor Maintenance

ELECTRIC MOTORS are the muscles of industry and if they are regularly serviced they will give dependable, long-time service. But neglect leads to breakdowns—with consequent interruptions in production—and, perhaps, to fire.

The following ten commandments of motor maintenance should always be observed, but, at the same time, shops where motors are used should always be protected with suitable types of approved fire extinguishers. Vaporizing liquid and carbon dioxide are suitable for this purpose since their contents are non-conducting and will not cause corrosion or otherwise damage motors.

I. Open-type motors should be blown out weekly; those operating under severe conditions, daily. Use no more than 50 lb. of pressure to avoid possible damage to insulation.

II. Follow manufacturer's instructions in lubricating motors. Too much oil is as bad as too little, causing deterioration of insulation.

III. Inspect bearings weekly or oftener. Feel temperatures, examine for excessive end play, and make certain oil rings are working.

IV. Inspect brushes and commutators weekly or oftener. Make certain brushes are seated perfectly and commutators are smooth. Use proper grade of carbon brushes to prevent wear of commutator and reduce sparking.

V. Where motors operate with excessive belt tension, check the air gap between rotor and stator every week. A monthly check of motors in average use is sufficient. Difference in the width of the gap around the circumference of the rotor will indicate extent of wear on bearings.

VI. Where motor leads are exposed to view, check them weekly to see that connections are tight, well insulated and protected, and free from oil.

VII. Inspect ground connections weekly, keeping them tight and in good condition. This is for the protection of employes, and for the proper operation of over-current protective devices.

VIII. Set up a regular schedule for overhauling motors. Most motors should be overhauled annually, while those in severe use should be overhauled twice a year or oftener.

IX. Dismantle the motor for a complete overhaul job. Wash all parts with carbon tetrachloride or some other safety solvent. Paint the windings with a good, oil-resisting insulating varnish.

X. Keep the area around the motor as clean as the motor. Arcing frequently ignites oily material that has not been cleaned up.

When fire breaks out in or around a motor, shut off the power before attacking the flames, if possible. Do not depend upon the circuit breaker operating or a fuse blowing out, but shut off the power. This will minimize damage to the motor and prevent continued arcing from re-igniting the fire. When the motor or conductors are dead, direct the fire extinguishing agent into the motor or upon whatever is burning, just as in any other fire. As soon as the fire is out, ventilate the area thoroughly to clear out smoke and fire gases.

* * *

To protect power lines, engineers have plotted probability curves from accumulated data to show how often thunderbolts are likely to strike. These charts show that every 50 mi. of power line will be hit by lightning an average of 50 times a year and each stroke will have a voltage of between 20 and 30 million volts.

Rewiring for Commercial and Industrial Buildings

PART 2

As explained in the first article of this series the material here presented is abstracted by special permission from a booklet* published recently by the Wiring Sales Committee of The Edison Electric Institute on the same subject. This deals essentially with the use of the newly developed small diameter wires in adapting existing electrical systems to the increased loads imposed by war work. This installment deals specifically with the characteristics of electrical distribution systems

IN MAKING use of the small-diameter building wires discussed in Part I of this article,[1] it is well to begin with a good general understanding of the character and arrangement of electrical distribution systems in buildings. Figure 1 shows the general arrangement and principal parts of the electrical supply system within a building.

The interior wiring system of a building is dependent upon, and to a large degree corresponds with the type of service available from the electric utility company's distribution system.

The principal types of electrical supply arrangements are illustrated in Figs. 2 to 7, but the following comparison will give an idea of the comparative value of 2, 3 and 4-wire systems.

Consider a 15-amp. branch circuit of No. 14 wire, and that a circuit length of 80 ft. requires 1 lb. of copper per wire. If voltage drop is not considered, then:

1. A 2-wire 115-v. a.c. or d.c. circuit will supply a 1725-w. load, or 863 w. per lb. of conductor.
2. A 3-wire 115/230-v. a.c. single-phase or d.c. circuit will supply 3450 w., or 1150 w. per lb. of conductor.
3. A 4-wire 120-208-v. 3-phase circuit will supply 5400 w., or 1350 w. per lb. of conductor.

It will be seen that this factor is important in rewiring, for the wire capacity of the existing conduits is limited, and a change to another system can be utilized for a large increase in electrical capacity of the rewired conduits.

The terms, "service, feeder, panelboard, branch circuit" used in Fig. 1 are defined in Article 100, pages 9-18 of the 1940 N. E. C. and familiarity with them will be helpful in making use of the following information.

Types of Electrical Service

The term "service" is defined as the conductors and equipment for delivering electrical energy from the utility company's distribution system to the wiring system of the building. Figures 2 to 7 illustrate the more common types of service supplied by the electric utility companies. The number of wires and the voltage between them will serve to identify the different services.

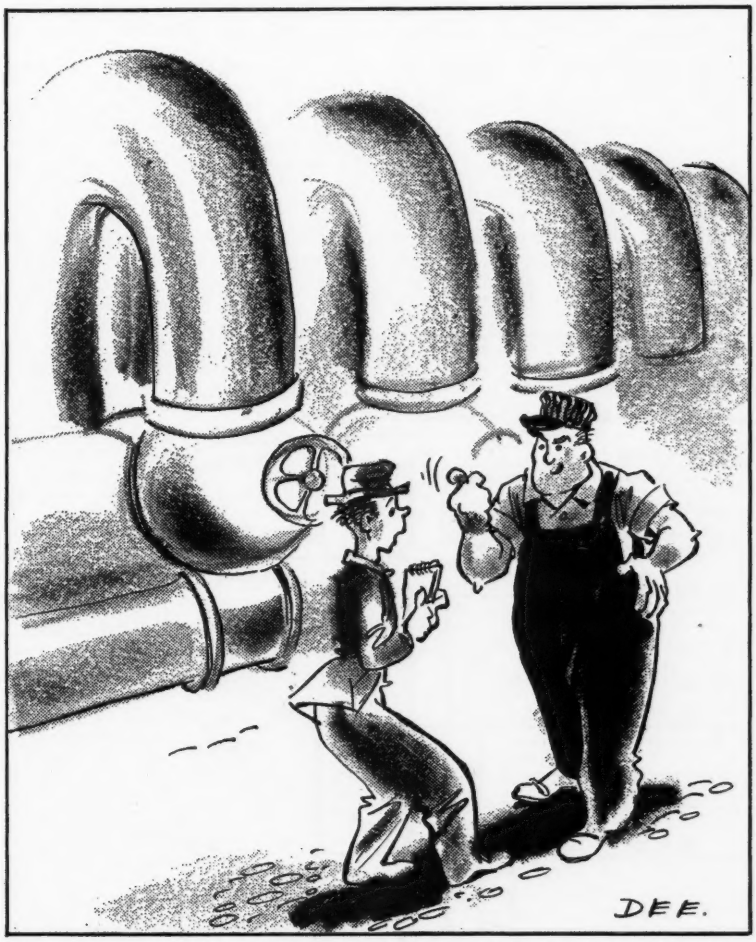
If any other types of service are encountered the local electric utility company should be consulted before making any changes, for it is probable that the service may be converted to a more desirable type.

The existing wiring system in the building will be found to correspond with the present service, and the rewired system should be planned to correspond with the most advantageous type of service available for the size and kind of load to be served.

For example, the 4-wire, 3-phase services shown in Figs. 4 and 5 are desirable for larger buildings, especially where elevators, large motors, or heavy appliances will be operated. But these systems will be an extravagance for a smaller building where 3-wire, single-phase service (Fig. 3) would adequately provide for all present and future loads.

In some cases it may be desirable to plan the rewiring for a 4-wire system, even though the present loads would not warrant the immediate installation of a 4-wire service.

Any existing 2-wire service and wiring system should always be expanded to at least a 3-wire system. Multi-wire branch circuits are provided for in Section 2104, page 27 of the 1940 N. E. C. In the rare in-



"Do you ever need a strong man around here just to bend pipes like those or things?"

*Rewiring For Commercial and Industrial Buildings. Edison Electric Institute, 420 Lexington Ave., New York, N. Y. Price single copies 25 cents each.

[1]Page 90, Dec., 1942, issue.

Table 3—Increased Capacity in Rewired Feeders

Size of Conduit, Inch	Existing 2-Wire Circuit Size & Type Wire	New 3-Wire Circuit Size & Type Wires	Increased Capacity, %	Existing 3-Wire Circuit Size & Type Wire	New 4-Wire Circuit Size & Type Wires	Increased Capacity, %
		All Wires Insulated				
¾	8 R	5 SN	260	10 R	8 RHT	194
1	6 R	2 SN	284	6 R	4 SN	116
1¼	2 R	1/0 SN	182	3 R	2 SN	80
1½	1/0 R	3/0 SN	150	1 R	1/0 SN	90
2	4/0 R	*2/0 SN	106	3/0 R	4/0 SN	65
2½	350,000 R	*4/0 SN	106	250,000 R	*2/0 SN	39
3	600,000 R	**4/0 SN	106	500,000 R	*4/0 SN	16
		Un-insulated Neutral in New Circuits				
¾	8 R	4 SN	311	10 R	6 SN	224
1	6 R	2 SN	284	6 R	3 SN	149
1¼	2 R	2/0 SN	222	3 R	1 SN	106
1½	1/0 R	4/0 SN	209	1 R	2/0 SN	118
2	4/0 R	*3/0 SN	136	3/0 R	*1/0 SN	74
2½	350,000 R	**2/0 SN	132	250,000 R	*3/0 SN	59
3	600,000 R	**4/0 SN	106	500,000 R	*4/0 SN	16

* Two wires in parallel per leg. ** Three wires in parallel per leg. See Section 3008, page 89, of 1940 N.E.C.

stances where multi-wire branch circuits are not recognized in local electrical codes every effort should be made to secure special approval for them in a rewiring installation because of the very large economies which their use makes possible.

Service Entrance

Service entrance conductors are commonly brought into a building through a steel conduit. Table 3 showing increased capacity for feeders is also applicable for service entrances, and the desired increase in capacity can frequently be obtained by rewiring the existing conduit. Section 2304 on page 41 of the 1940 N. E. C. provides for the use of an uninsulated neutral in service entrance conduit, so the bottom portion of Table 3 is particularly applicable. Service entrance conduit is usually accessible and when necessary the replacement of the entire service entrance does not usually involve any serious problem or large expense.

Service and distribution equipment are generally accessible and lend themselves readily to modernization and increased capacity. In some cases the existing service equipment and feeder panelboard may be of adequate capacity, or can be remodeled to accommodate a new service and larger, or an increased number, of feeder circuits. When new equipment is more advantageous, it can frequently be installed in the same locations, and being more compact may actually release valuable space for other purposes.

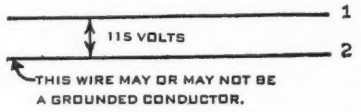


Fig. 2. Two-wire 115 v. a.c. or d.c. service Note: Direct current service is becoming obsolete, and 2-wire service for both a.c. and d.c. is being suspended by 3-wire 115/230 v. service because it provides additional capacity and both 115 and 230 v. supplies with only three wires

Feeder Circuit Possibilities

Feeders are defined as the conductors of a wiring system between the service equipment and the branch circuit over-current device. In some cases the feeder circuit or circuits will consist of the same number of wires as the service, while in other cases a lesser number of wires will serve as feeders to individual portions of the load.

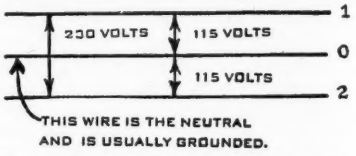


Fig. 3. Three-wire 115/230 v. a.c. or d.c. service

Feeder conduits sometimes seem to constitute a bottleneck in the rewiring of a building, but a little ingenuity in the selection of the type of service, use of small diameter building wires, conductors in parallel, un-insulated neutral and parallel conduit lines will provide increased capacity very economically.

Rewiring Feeders for Increased Capacity

Table 3 shows the increased capacity that may be obtained when a feeder conduit is rewired with small diameter wires, and changed from a 2-wire to a 3-wire system, or from a 3-wire to a 4-wire system. The upper portion of Table 3 refers to circuits with all conductors insulated. The lower portion of the table provides for an uninsulated neutral in the rewired installation.

For example, an existing 1¼-in. feeder conduit containing two No. 2 Type R wires can be rewired with

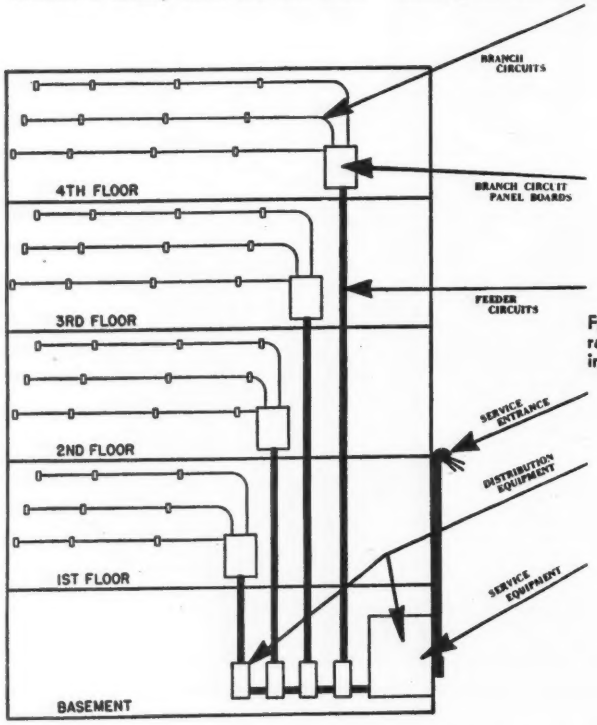


Fig. 1. General arrangement of building distribution systems

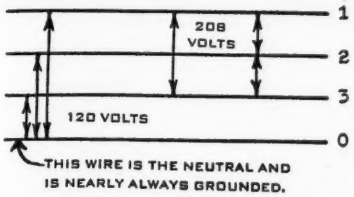


Fig. 4. Four-wire 120/208 v. 3-phase a.c. service

three No. 1/0 Type SN wires and the capacity increased by 182 per cent; by obtaining permission to use an uninsulated neutral No. 2/0 Type SN wire may be used and the capacity increased over three times that of the original installation.

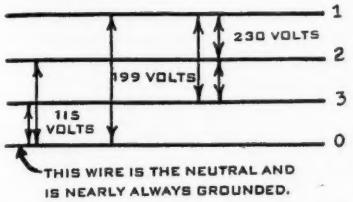


Fig. 5. Four-wire 115/230 v. 3-phase a.c. service

In addition to the increased capacity, the voltage drop is less in the rewired feeder than in the original installation. This is true in all cases shown in Table 3 except in the one instance where four No. 8 Type RHT are used in ¾-in. conduit. In this one case the voltage drop is increased by about 12 per cent. In the cases where a 3-wire feeder replaced a 2-wire feeder the voltage drop is approximately cut in half; where a 4-wire 3-phase feeder replaces a 3-wire single-phase feeder the voltage drop is reduced on the order of one-quarter to one-third.

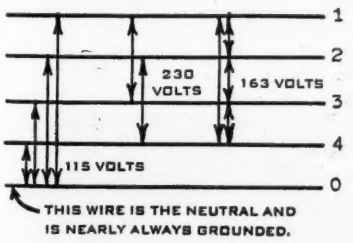


Fig. 6. Five-wire 115/230 v. 2-phase a.c. service

At present the largest size of small diameter wire is No. 4/0, with the result that more capacity can be obtained in large conduit sizes by using two or three wires in parallel in each leg of the circuit. Section 3008, page 89 of the 1940 N. E. C., provides that conductors may be run in multiple by special permission. This is especially advantageous for large feeders.

Factors Contributing to Increased Feeder Capacity

Five factors contribute to the increased feeder capacities shown in the foregoing table:

1. Change in type of service from 2-wire to 3-wire or from 3-wire single-phase to 4-wire 3-phase system.
2. Small diameter wire.
3. Increased conduit fill.
4. Conductors in parallel.
5. Un-insulated neutral conductor.

Two additional factors may also be utilized:

6. Reduced size neutral conductor.
7. Common neutral conductor.

The neutral conductor of a feeder need only carry the maximum unbalanced current as provided in Section 2204, page 39 of the 1940 N. E. C. Under some circumstances this makes a reduced size neutral possible. When two or three sets of 3 or 4-wire feeders are run in the same conduit, a common neutral conductor may be used as provided in Section 2205, page 40 of the 1940 N. E. C.

Still another means of obtaining increased feeder capacity remains. In some buildings it will be found entirely feasible to install a parallel run of conduit with the feeder circuits connected in multiple. The new conduit run need not follow exactly the same path, but care should be taken that the separate feeders be joined together mechanically and electrically at the

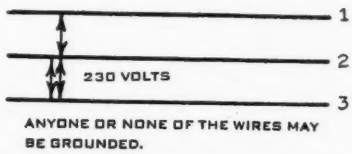


Fig. 7. Three-wire 230 v. 3-phase a.c. service

terminals. Special permission will usually be required for this procedure, but it is especially practical where space is available in a shaftway.

Panelboards and cabinets containing the switches and over-current devices for final branch circuits are generally accessible and lend themselves readily to modernization or replacement for increased capacity. In some cases new panelboards will be advisable. In other cases, some of the older double-fused boards can be remodeled for twice the number of single-fused branch circuits by the addition of a neutral bus to the panel.

Keeping Electrical Starters Operating

A PROGRAM of constant checks against oil, dirt and moisture that enabled one large manufacturer to run 6500 electric motors for 10 yr. with only 10 min. lost time due to power failures was described recently to the Electrical Association of Rochester.

Oil, dirt and moisture, explained L. E. Markle, control equipment engineer for the Westinghouse Elec. & Mfg. Co., are saboteurs which ruin electric motor starters so important to plants depending on electric power to drive their machinery.

This particular plant, the group was told, adopted a vigilant maintenance program and immediately discovered that practically all its starters and other equipment needed attention. Since regular inspection and cleaning were started, there have been almost no shutdowns. Such programs are more important than ever before, to keep the motors turning to meet the demands of war. Rest periods are short or may not occur at all. Machinery that lay idle for years has been pressed into service although it may not be in first-class condition.

Close cooperation with manufacturers by motor starter users may point the way to change in design that will reduce the need for maintenance and prevent shutdowns for repairs. Re-design and improvement of a few parts have been known to increase the useful life of a complete starter for a long time. No matter how good a design may be it can always be applied to some service or in some atmospheric conditions where its performance may not be entirely satisfactory.

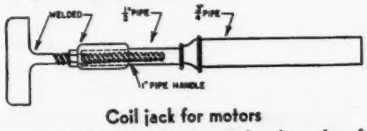
Coil Jack for Motors

By T. E. MILLER

A RECENT repair job on a large induction motor required replacement of several coils. The necessary coils were made up of available flat wire slightly larger than the original and fit the slots so tightly that driving them in was certain to damage their insulation.

We made up a jack which proved very useful in "pushing" them in place and also much safer in replacing the old coils that had been raised. They were very dry and brittle and probably would have cracked under the usual pounding methods.

A piece of flat iron ⅜ by 1¼ by 6½ in. long was centered on edge and welded to a 16 in. long and ⅝-in. rod threaded 13 in. of its length. The top edge of the flat iron was carefully smoothed for use as the jack surface in pushing in coils.



Coil jack for motors

A ⅝-in. nut had a 4 in. length of 1-in. pipe welded to it which serves as a handle to turn the nut and apply the jacking action. The threaded bolt slips into the ½-in. pipe with very little play and the long threaded section inside prevents bending at the point where the nut pushes against the pipe. The 1-in. pipe handle is evenly peened on the outside until it barely clears the ½-in. pipe but still will turn freely. This helps make the moving joint more rigid. The foot of the jack was made of ¾-in. pipe to give overall length of 42 in. This figure would of course vary according to the inside diameter of the stator being rewound.

We used a 4 by 6-in. timber across the laminations to jack against and found that the 1-in. pipe hand grip on the jack nut gave all the push that the coil could safely stand. The jack was also useful in setting coils just ahead of wedges all of which went in tight.

Casting Lugs on Ends of Wire Rope

Here is a description of a simple and effective way of casting lugs on the ends of wire rope. It makes use of split molds made of steel which can easily be made in any plant. Soldered lugs on the ends of wire rope not only lessen the chance for injury in handling but provide a means for attaching the ropes to various types of equipment. Wire rope is hard to get so take care of the ropes on hand

By C. R. HOCHMUTH, Assistant Works Manager, Kearney & Trecker Corp.

WE HAVE ADOPTED the practice of casting a lug of solder onto the ends of many of the wire ropes used in our factory. The only exceptions are some of the hoist ropes, which are ended in a basket-type socket, and some of our slings in which the end of the rope is spliced into the rope body to form an eye or bight.

The soldered lug serves several purposes: First, it eliminates the exposed ends of the wires, which are a source of injury and infection to riggers and others handling the rope. Second, it serves as a means for readily attaching hoist ropes to the drums of overhead traveling cranes. Third, where ropes are fastened by clips, the lug on the rope end provides an additional safety feature inasmuch as should slippage of the rope occur the last clip will catch the lug and hold the rope.

Because of its ease of handling, lack of tendency to fly apart, and its resistance to fatigue, preformed rope is being used throughout our plant for crane and hoist ropes and for many of our slings. Since this rope requires no seizing at the ends to hold the strands in position, it lends itself better to the casting of solder lugs on the ends. For this purpose we have made some split molds of steel, similar to the one shown in the sketch. These molds are provided for all the sizes of rope we use. The two sections of each mold are held together by means of two screws passing through one section of the mold and into the other section. The mold shown in the sketch will accommodate three sizes of rope, each size being stamped on the mold by means of punches.

To prepare the end of the rope, the strands are unlayed for about an inch and the hemp center is cut back the same distance. The unlayed strands are then cleaned of lubricant and grime by dipping them into a half-and-half solution of commercial muriatic acid and water. The rope should not be inserted so deep that the acid will get on the hemp center. The strands are then tinned by dipping them into molten solder. It may be necessary to dip in acid and solder several times before a good tinning job is obtained. By bunching the strands together they are passed through the bottom of the mold, and then are spread apart, after which hard solder is poured into the mold. After the solder cools, the screws holding the mold together are removed, allowing the two mold sections to be separated so the rope with the attached lug of solder can be removed.

To eliminate sharp edges, which might cause scratches or cuts to the hands of those handling the rope, the edges of the lug are filed slightly round.

Where solder lugs are to be applied to ordinary, or non-preformed rope, it is necessary to apply a seizing of soft wire to the rope at a point just below the bottom of the mold, to prevent the strands from raveling. The seizing must be applied before the strands are opened up, and it should be followed by another seizing an inch or so below the first. After the lug is cast, the seizings may be removed.

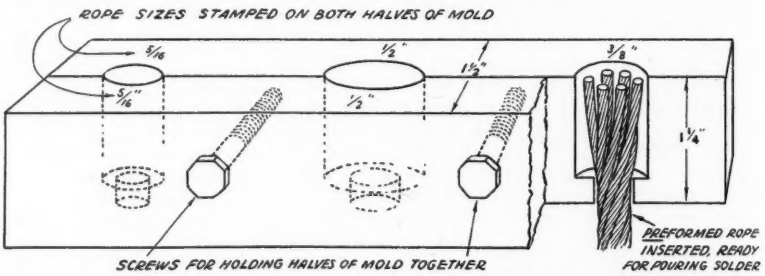


Fig. 1. Diagram showing the construction and use of the steel molds used in casting the lugs

Fig. 2 (left) The split steel mold is firmly held in a bench vise while the solder is poured around the ends of the ropes

Fig. 3. (above) A photograph showing the finished lugs

The Why, When, Where, What and How of FLOW METER INSTALLATION

Part V.[1] Piping the Flow Meter so as to avoid air pockets, leaks and uneven reservoirs which cause false differential pressure readings, and, to allow blowing down and cleaning at regular intervals

By W. C. BENNETT
Cochrane Corp.

AFTER the orifice or flow nozzle has been properly installed, the pressure taps made and the meter body in place, all that remains to be done, before putting the meter in service, is to complete the piping. This is extremely important if the meter is to give accurate readings and trouble free service. The illustrations, Figs. 1 and 2[2] illustrate general piping recommendations rather than detailed arrangements for different applications.

While copper tubing is preferable, at the present time copper is not likely to be available so that iron pipe will probably have to be used. This should be installed with the following points in mind:

1. Pipe of ⅜ or ½ in. nominal diameter is recommended for installation between the metering element and meter. Connections at the metering elements are usually ½ in. size and at the meters ⅜ in.

2. Employ unions in the piping both at the metering element and at the meter to facilitate cleaning out the lines in the future.

3. Before installing the pressure piping, rap it strongly to shake loose all scale and dirt.

4. It is essential to arrange the pressure piping in such a manner as to prevent air being pocketed and creating a false pressure differential. In Fig. 1 (A) a false rate of flow is indicated due to presence of air in the incorrectly sloped piping of a steam or liquid meter. Similar errors would exist in the case of air or gas measurement, if the piping contains pockets for collection of moisture. See that all horizontal runs of pressure piping slope downward to the mercury element, without air or moisture pockets and with a minimum slope of 1 in. per ft.

5. Pressure piping must be free from leaky joints. Fig. 1 (B) shows the false pressure differential caused by a leaky pipe coupling, even though there is no flow of fluid through the pipe line. A leaky connection in the low-pressure piping causes the meter to read too high; a leaky connection in the high-pressure piping causes the meter to read too low.

6. Condensation reservoirs must be installed at the level of the two pressure connections when measuring steam, and, one must be at the exact level of the other in order to maintain equal water legs in each connection. If one reservoir is higher than the other, serious errors may result. Fig. 1 (C) illustrates how a false pressure differential results from unevenly leveled reservoirs, even though no flow exists through the pipe line.

7. Unless the pressure piping is blown out at regular intervals, it is only natural to expect the pressure piping to fill with dirt. The meter will then act sluggishly and will not show the variations in load sensitively. To clean the pressure connections at the orifice, remove the stems of the orifice valves and run wires through the connections. This can sometimes be done while the line is under pressure. Clogging, however, will not occur if the piping is blown out regularly.

[1]Part I, Why, When and Where Flow Meters are needed, appeared on pp. 88 and 110 of the October issue; Part II, How Flow is Measured, appeared on p. 97 of the November issue; Part III, How to Select Primary Elements and the Most Desirable Differential, appeared on p. 92 of the December issue; and Part IV, Where to Install the Orifice or Flow Nozzle, appeared on pp. 91 and 108 of the January issue.

This series of articles considers only practical flow meter use and installation for those reasonably familiar with general theory and construction. For a complete development of the theory and a comprehensive treatment of fluid measurement the author refers interested readers to the publication of the A.S.M.E. Special Research Committee on Fluid Meters. These are available in three separate volumes: Part I on theory and application covers the classification of all types of fluid meters, develops the theory, gives physical contrasts and meter coefficients and includes an extensive bibliography. Part II describes the individual makes of meters (both primary and secondary devices) in commercial manufacture. Part III covers selection and installation. These are available from the American Society of Mechanical Engineers, 29 West 39th St., New York City, at the following prices: Part I, $3.00; Part II, $1.75; and Part III, $1.50.

[2]For mechanical reasons Fig. 2, a full page chart showing piping arrangements for typical meter installations is placed on the last page of this section.

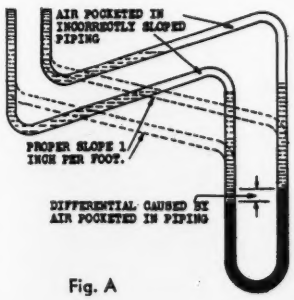


Fig. A

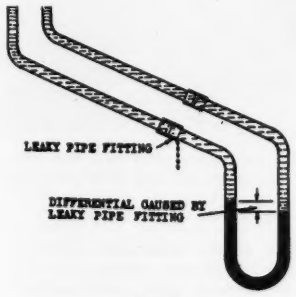


Fig. B

Fig. 1. Three precautions that must be taken if the meter differential is to be accurately measured: A, piping sloped properly to prevent air pockets forming; B, pressure light fittings; C, reservoirs located at the same level (in the drawing below the reservoirs are not level and they give a false differential)

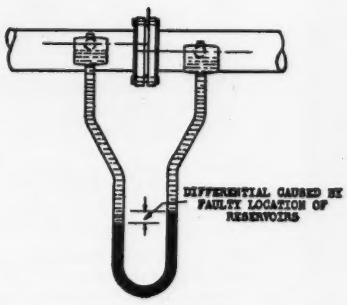


Fig. C

Temporary Repair Provides Emergency Steam

WHEN a big leak developed recently in a 16-in. cast-iron main carrying low-pressure steam to heat five buildings at General Electric's Schenectady Works, an ingenious method of quick, temporary repair maintained the supply until the pipe could be replaced.

In the temporary method, which was devised by J. E. Schoenborn, general foreman of the steam fitting crew, four ⅞-in. studs were used to exert enough pull on the pipe's expansion joints to close the leak, a saw-toothed crack open one-half inch. The studs were run through the end flanges of the 12-ft. section in which the crack was located and the pipe was pulled together by tightening the studs. A few light blows with a hammer around the crack seated the broken ends so that leakage was negligible.

How To Start a Gas Engine Without Breaking Your Arm

Here is a simple and effective way of starting small and medium size gas engines without danger of breaking arms or legs in the process. A pre-compressed explosive mixture of gas and air is stored in a tank. In starting, the gas engine cylinder is charged from this tank and fired by snapping the ignition

By CHARLES C. LYNDE

WHERE HEAVY, slow-speed gas engines are to be started in power plants having but one or two attendants on duty per shift, the chore of kicking off the engine involves considerable work and introduces the hazard of possible accident through premature firing of the charge as it is compressed within the cylinder.

To avoid these drawbacks, one company using a number of 2-cylinder, 2-cycle 150-hp. horizontal engines as prime movers in isolated locations devised a modified air-starting system which did away with the need for installing a heavy air storage tank and the compressor capacity necessary to maintain it charged, and at the same time made the task of starting any engine simply that of rocking it by hand—with compression released or reduced—until the right-hand piston was just past compression center in the normal operating direction.

A charge of pre-compressed gas-air mixture, in proper proportions to ignite by spark, is then admitted to the right-hand cylinder through special charging line, the ignition snapped, and the engine thus started under a fired charge of sufficient power to insure rolling until the unit has taken up the normal cycle of operation and is warming up properly.

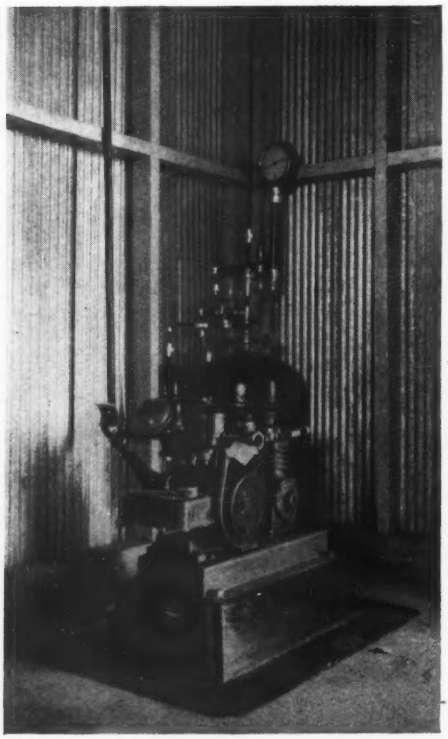
Starting the unit is thus much akin to the old method of starting with the blank shotgun shell, with the improvement that repeated starts may be made in the same manner without lost time other than that required to spot the proper piston.

It is in the compression and storage of the starting mixture that the ingenuity of the system is most apparent. A small, garage-type single-stage compressor, V-belt driven from a 1-hp. air-cooled engine, serves in place of the heavier unit required for full air starting. The intake of the compressor is controlled by a three-way valve, the two runs being open to air and tied in to the natural gas fuel line respectively, the branch being connected to the compressor inlet through a short nipple. Simply by proper setting of the three-way valve, then, the compressor may be made to compress either air or gas.

Two types of storage for the compressed charge are used. Where a single sphere is used the storage unit, some 15 in. in diameter and supported on a tripod just beyond the compressor, is first charged with gas, then air added. Assuming that the sphere has been blown down to atmospheric pressure, as must be the case for proper proportioning, the compressor is set to compress gas, and the sphere filled until the gage registers a pressure of 5 lb. The valve is then charged to cause air to be drawn in, and the pressure built up to 125 psi. This pressure is that used to fill the compression space of the engine with mixture so proportioned and compressed as to ignite with normal spark.

The charging valve on the engine cylinder head must be held open by hand to permit the mixture to enter the cylinder, being closed as soon as hand pressure is released. Since the firing mechanism on the magneto is at the crank, an appreciable time must elapse before the operator can detonate the mixture. The charging valve also contains, as additional precaution, a snuffer or section of fine screen which effectively damps out any flame and prevents its propagation back through the ⅜-inch pipe to the storage units.

Where the snuffing device is not part of the starting valve, it is installed at



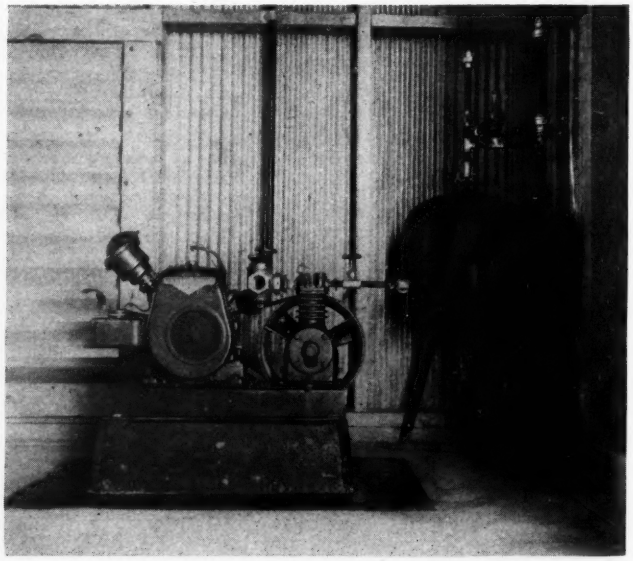


Fig. 1. (Left) Unit mounted compressor and power plant with dual storage spheres in the background for separate charges of gas and air at the required kickoff pressure. Single gage and outside mounted safety valve provide close check on maximum values reached during compression

Fig. 2. (Right) Three-way valve mounted on the compressor intake affords selective compression of either gas or air to spherical storage unit. Use of common inlet fitting prevents possibility of explosive mixtures being compressed within cylinder of compressor and insures proper charge to storage unit or units

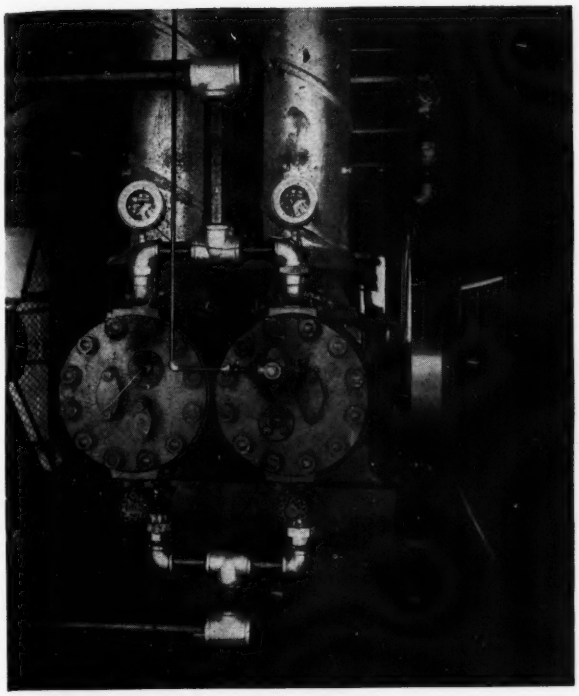


Fig. 3. Single ⅜-in. pipe and special valve built into one cylinder head provide means for introducing high-pressure to engine, when operating cycle is started by snapping the ignition switch and setting engine rotating in the proper direction for work

the bend of the charging line nearest the roof, being vented through a spring-loaded branch line so that an explosion, traveling back to the snuffer, is relieved to atmosphere outside the roof.

Where objection might be raised to the continued storage of an explosive mixture within the station building, the system has been revised to call for two storage spheres, connected to the discharge line of the compressor, and of diameters to give volumes in the proper proportions of 10 to 1 when opened to the engine starting line.

With this latter system the compressor may be used on either air or gas, the small sphere being charged with gas to the starting pressure of 125 lb. and the large one with air to the same gage. Both spheres are connected in to the engine starting line, and with both valves opened each discharges a proportionate part of its contents into the ⅜-inch starting line. A thorough mixing of air and gas is obtained during flow to the admission valve set into the cylinder head.

The storage spheres, welded throughout, are hydraulically tested under pressures of 500 psi before being used for storage of the starting mixture under pressures amounting to only one-fourth the test value. Installation of a single gage, with relief or safety valve on the same line as the gage, prevents charging a sphere to more than the predetermined maximum pressure and also through the use of a single gage, insures proper proportioning of the gas and air as stored.

Prompt Starts, Prompt Promotions

By FRANK V. FAULHABER

"BREAK IT UP! Break it up!" said the chief engineer, who had suddenly popped up from nowhere, and like snowflakes on a hot stove the individual staff members who had gathered for gossip vanished, scattering to their respective jobs. It was already 15 min. past starting time, some of the men lingering in a bunch to talk over one thing or another, as individuals are likely to do, a pleasant practice perhaps, but one that is often very much overdone in some power plants.

"I'm reasonable," explained the chief. "I did the same thing myself at times when I first started. Men will come in, on time, but then they assemble discussing various topics, and before anyone realizes it the session extends beyond the plant's starting time, which, here, is 7:00 A. M. meanwhile a number of the tasks must remain undone. That, I can tell you, mounts up considerably, in the course of a year!

"Frequently these spontaneous get-togethers take place even during the course of the working day, indeed, they are quite pronounced after the lunch period. Men naturally like to talk, but some laggards will chatter on and on, the blowing of the whistle seemingly meaning little to them, except when it's time to quit, and then they wait for it!

"Of course, I know these men and if they think I do not know what is going on, they're in for speedy disillusionment! On the other hand I have men on the staff who, day in and day out, start the working day on the dot, and always remain to give an extra good measure of work.

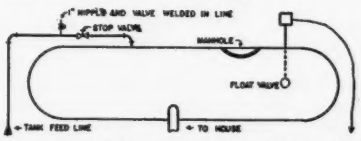
"Need I tell you," said the chief, "that I keep all this in mind when promotion times come around? These lingerers think they are putting something over on me, do they? If they're puzzling and wondering why their pay-envelopes don't show increases enough, you can be sure their impromptu talk-fests have something to do with it! They're not cheating the plant and me so much as they're cheating themselves! To a certain point, I can overlook these rag-chewing prologues and interludes, especially when I know that the participants are good engineers, but their gossip swappings are never assets.

"More than once, when it was a question of which man to let out, the fact that one was known for talking too much on shop time, decided the issue—in his disfavor, of course! Some of these lads labor under the misapprehension that so long as their time-cards indicate punctual attendance, their time requirements are fulfilled! For these and other similar misguided saps, let me emphasize that I'm not so much concerned with the amount of time they put in on the job as what they do during that time! Come in early, yes, but once it's time to start to work, *start!*—and keep on the job until it's time to *stop!* Take it from me, that's one sure-fire way of getting ahead instead of being left in the background!"

A Dirty Water Problem Solved

By EDWARD PODMAYER

AFTER taking charge of a large hotel, complaints of dirty water led to an inspection of the roof tanks located on the 22nd floor. Opening the manholes disclosed where most of the trouble was coming from for the inside of the tank was a mass of barnacles and rust. One tank was shut down and men put to work cleaning and scraping.



Nipple and valve welded to feed line helps solve dirty water problem

We then had to find some means for washing the tank out with water, there seemed to be no water under pressure available. This was solved by welding a 1-in. nipple and valve in the feed line behind the main shut-off on the tank. This job completed, it was possible to close the main shut-off valve to No. 1 tank and start the water pump in the engine room by working the float control manually.

By closing the main valve the pump built a pressure in the feed line and by connecting a hose on the 1-in. line we were able to give the tank a good wash. We then gave the interior of the tank a coat of special aluminum paint.

From then on we were not bothered by dirty water and with yearly inspection of the tank we maintained a good clean tank as the light aluminum paint would show up the least amount of dirt accumulating inside.

LETTERS AND COMMENTS

Pro and Con on Malarkey's Don'ts

I have just read Mr. Malarkey's "Refrigeration Dont's" in the November P. E. & E. I would like to comment, both pro and con.

Speaking generally, I am not given to tight rope walking, at least when the rope is more than a foot or two above the ground. I prefer broad understanding on which to place my number nines. Nor do I like to gamble with money, much less with my neck. Yet on looking back over my experiences around mines, machine shops, power plants and refrigeration systems, I find that there have been several occasions when I did not hesitate to do a thing the dangerous way when that way seemed necessary or best.

From the viewpoint of safety engineers, I have taken chances. Yet to date my most serious injury in life was a cracked rib acquired playing ball. And my only scar was presented me by an old belt driven motorcycle. I was cranking it, not riding it at the time. My only injuries from other machines were skinned knuckles, blackened fingernails and an occasional burn—too minor to wrap up—the same kind of injuries I have received doing chores around home. I have been near when serious accidents happened to men and to machines. But no serious accident has ever happened to a machine I was operating or to a machine in my charge.

You may call this luck. I sometimes think so myself, for there have been several occasions when I have deliberately violated several points in the accepted codes of safe practices.

Take Mr. Malarkey's "Don'ts" for example. I have charged ammonia through the compressor, although with the machine suction valve throttled to less than a full turn open. And when the alternative was a long pump-out and shut-down, I have tightened various sizes of flange bolts with the system under high pressure. I knew quite well that I was gambling against a blow my feel of what torsional stress each size bolt could stand.

The closest call I have had in several years of managing the refrigeration end of a small ice plant and cold storage was in the simple act of opening at ½ in. ammonia valve. In our spare time I was breaking in a rookie ice harvester as an engineer. He was an apt student, and had mastered the theory of the game rather thoroughly.

One day he went into the tank room to open a ½ in. tee-valve on the liquid line. Soon he reappeared, commented that the stem packing leaked, and took a wrench to tighten the packing nut. I followed shortly, drawn by the strong smell of ammonia. As I stepped into the room I saw him, with eyes closed and head averted from the ammonia spewing from the valve, frantically turning the wheel in an effort to backseat the valve and stop the blow.

I also saw something else, something he couldn't see with his eyes closed and head turned away. I let out a yell, all the echoes of which have not come back yet. I also made one of the quickest moves of my life. I swung around a railing and knocked his arm away from the valve. With my eyes shut and holding my breath, I gave the wheel a turn or two in the other direction, then sprinted for air and the gas mask.

The rookie had not been backseating the valve, as he had thought. And the packing had not been leaking in the first place. The leak had been at the gasket of the screwed-in bonnet. Yet the rookie had screwed up the packing nut so tightly that the packing had gripped the stem. Instead of backseating the valve, he was screwing the bonnet out! The pressure was 190 lb. gage, and the valve was on a liquid line 20 ft. from the receiver containing a ton of ammonia. I still break out in a cold sweat when I think of what would have happened in another second.

I mention this instance to show that there may be danger attached to the most simple acts in operating refrigeration systems, and to stress my belief that the chief danger about a plant is not in performing acts which are dangerous, but in being unaware that what is being done is dangerous.

Who is in the most danger, a performer on a flying trapeze, who is acutely aware of his position, or the driver of a car speeding blithely across street intersections or railroad crossings? And who is in the most danger, an alert engineer charging ammonia through the compressor, or the rookie in the above mentioned instance?

To sum up, I'd say that the best safety practice about any plant is:

Keep your ears cocked and your eyes peeled, or

You'll git your eyes cocked and your ears peeled.

GEORGE HOLMAN

The Editor's Face Is Red

YOUR November issue of POWER PLANT ENGINEERING had a very interesting article by Andrew Kramer, entitled "Loads and Load Curves as Influenced by Blackouts". I was considerably amused by the caption of one of the figures, and wonder if any other Canadian may have brought it to your attention.

Figure 4 on page 56 was titled, "Toronto Hydro Load, Prewar Blackout on Sept. 10, 1941." I consider that error to be typically 'American', and may I ask if you are not afraid of incurring the displeasure of some of those people who had already been helping to hold back the forces which were arrayed against Democracy for over 2 yr. on the date referred to above?

Come now, we know that Dec. 7, 1941 was a very important date in history, but surely you had heard that there was a war on before that, and that Canada was in it! Tut! Tut!

While I am writing may I express my sincere appreciation of your fine publication POWER PLANT ENGINEERING.

St. Catharine, Ont., Canada — ARTHUR D. SMITH

EDITORS NOTE. *My face is plenty red. I extend my sincere apologies to Canada and to all Canadians for my thoughtlessness. Really, I did not know that there was a war on before December 7, 1941, if for no other reason than that I visit Canada every summer, in fact I have not missed a summer vacation in the Canadian Rockies for 15 yr. I count among my best friends the Canadians we meet and visit with each year and we knew from them that there was a war on long before Pearl Harbor. If someone else had made this error it would be typically American as you put it, but in this case I can assure you that it was just plain thoughtlessness.*

Forced Draft—Round and Round It Goes

EDITOR'S NOTE: On page 94 of the February, 1942 issue, E. M. Sims presented an article entitled "How To Determine Forced Draft Air Requirements." The method described was based on an assumption that the theoretical weight of air for complete combustion of 1 lb. of different fuels is a constant per 10,000 B.t.u. in the fuel. In the June issue, on p. 84, W. S. Patterson commented on Mr. Sims' article, pointing out that while Mr. Sims' method was correct as far as it went, there were other factors to be considered in addition to those enumerated by Mr. Sims. This comment by Mr. Patterson got our old friend Joe Darnell all steamed up, so much so that on p. 86 of the August issue, he came forth with another high-powered discussion of the whole question of forced draft air requirements. In this article he took exception to a number of the factors presented by Mr. Sims.

It seemed that, with Mr. Darnell's article, the subject would have been pretty well exhausted but not so, for in the November issue, p. 104, Associate Professor Leonard of mechanical engineering at Oklahoma A. & M. College stuck his neck out, as he put it, and said he was unable to agree with some of Mr. Darnell's calculations. This got Joe all steamed up again and in the same issue he replied to Mr. Leonard's criticism. Finis? No, indeed. The highly refined name-calling which had crept into the controversy aroused Mr. Patterson's ire (not really) and since he felt that his comment in the June issue was responsible for setting Mr. Darnell off, he now comes to Mr. Sims' defense with the letter presented below. The same afternoon that Mr. Patterson's letter reached my desk, came another letter from Mr. Leonard. Well, if you have been able to keep all this straight and if you are still interested in the subject of forced draft requirements, you are now ready to read the following letters. We wish you luck. Despite their differences, it seems that all of these fellows know a few things about forced draft so I won't shut the discussion off unless it gets too hot to print.

Mr. Patterson Takes the Floor

MR. SIMS' well-intended article in the February, 1942 issue has resulted in some highly-refined name calling. And, since the writer's comments in the June issue can be blamed for launching Mr. Darnell off, on his August, 1942 article, I am offering further comments in defense of Mr. Sims.

Unfortunately, Mr. Sims used as a basis for his article a table from L. A. Harding's book, and this table, even in the book, contains the errors which Mr. Darnell pointed out. However, we must not lose sight of the fact that the title of the original article was "How to Determine Forced Draft Air Requirements," the inference being that a forced draft fan selection was involved.

My published comments in the June issue pointed out certain errors of omission that might result in the wrong fan selection but did not criticize the basic assumption of 7.65 lb. of air per 10,000 B.t.u.

Anyone who has selected many power plant fans knows that even refined engineers do not find it necessary to use refined combustion calculations for fan selection, but there are, as the writer pointed out, several allowances of considerable magnitude that had not been mentioned by Mr. Sims. Certain of these may affect the calculated required fan volume to the extent of 20 per cent and the required pressure 45 per cent, and it is this type of correction, rather than the minute details associated with combustion calculations, which is of real importance in fan selection.

It is obvious, to the writer at least, that Mr. Sims was not attempting to write a doctor's thesis on combustion calculations but rather to present a quick method of approximating the air requirements for fan selection. Fans are normally picked with large tolerances (sometimes the equivalent of 25 per cent excess on both volume and pressure); so the short cuts in the combustion calculations should be considered in light of their effect on the final answer.

Mr. Darnell points to the use of 7.65 lb. of air per lb. of fuel as one of the basic errors of Mr. Sims' method, but this figure is only about one per cent higher than the figure for bituminous coal which has been used by the writer with good results for 10 yr., during which time fans aggregating literally millions of CFM have been selected and placed in successful operation.

In a paper presented before the A.S.M.E. Metropolitan Section on October 21, 1942, by the writer and one of his associates, A. L. Nicolai[1], tables of air requirements were given for a wide range of fuels of various types. The tabulated values are in terms of "atmospheric air" in lb. per million B.t.u., based on A.B.M.A. Code air humidity. For convenience in comparing these figures with others for dry air, the accompanying table has been prepared by converting the median values to the "dry air" basis.

There may be freak fuels of each classification that might fall outside the ranges given, but a careful study of hundreds of analyses was made. It will be noted that the median values for dry air do not agree with those in the table from Harding, or Mr. Darnell's Table I, but the average of the median for all coals, including anthracite, lignite, and fuel oils, is most identical with Mr. Darnell's average.

The writer heartily disagrees with Mr. Darnell's inference that it is necessary to calculate forced draft requirements from an ultimate analysis of each individual fuel under consideration. Why take an hour to do a job that can be done in 5 min. with satisfactory results? The user may buy coal from several mines or may not know the ultimate analysis, so time is lost writing letters or trying to find an ultimate analysis to agree with the given heat value or proximate analysis. Time is particularly precious to engineers these days, and with a table, such as that given below, it is easy to use a median or average value for a narrow group of fuels.

Mr. Darnell is certainly quibbling to argue a point that would affect the fan capacity calculations by 1 or 2 per cent and to point out that Mr. Sims' sample calculations used slightly inconsistent variables.

A large part of Mr. Darnell's article in the August issue has to do with heat balance calculations, apparently only because he wanted to prove that 85 per cent efficiency with 60 per cent excess air is impossible with 450 F. exit gas temperature. But who said anything about exit gas temperature? Mr. Sims' chart does not imply that 85 per cent efficiency may be obtained with 450 F., nor does it imply that it was not intended for use with a boiler unit having an economizer or air heater. On a unit with an economizer or air heater, the exit gas temperature might be 350 F., or lower, and the radiation loss (A.B.M.A. Code) 1.0 per cent, or lower; and, under such conditions, 85 per cent would not be unreasonable and certainly not impossible.

An expert quibbler might criticize Mr. Darnell's formula for calculating moisture and hydrogen loss, and his heat value of carbon in the refuse; or point out that he did not allow for moisture in the air in his heat balance nor in his air volume calculation, and that there are several errors in his carbon loss calculations.

Mr. Darnell seems to have missed the point that one of the largest corrections to be considered in selecting

[1]Combustion Calculations by Graphical Methods printed in Combustion, August, 1941 through August, 1942, seven issues.

Air requirements for fuels of various types

Fuel Type	Lb. air per million B.t.u. at zero excess air			Variation from Median % ±
	Range, Atmospheric	Median Atmospheric	Median Dry	
Coke	763 to 813	788	778	3.2
Pa. Anthracite	781 to 793	787	777	0.70
Semi-anthracite	768 to 782	775	765	0.90
Low-Vol. bituminous	765 to 776	770.5	760	0.80
High-Vol. bituminous	751 to 773	762	752	1.5
Lignite and Sub-bitum.	747 to 757	752	742	0.70
Fuel oil and gasoline	742 to 758	750	740	1.1
Natural Gas	732 to 741	736.5	727	0.6
Wood and Bagasse	702 to 728	715	706	1.8
Coke Oven Gas	666 to 702	684	675	2.6
Blast Furnace Gas	565 to 577	571	564	1.1

a forced draft fan is the furnace infiltration. This is *subtracted from,* not added to, the calculated volume since it is air which takes part in combustion but is not supplied by forced draft. In face of a large correction, such as this, which can only be determined by experience and the exercise of engineering judgment, is it justifiable to waste time over minutae?

Professor Leonard in the November issue agrees with Mr. Darnell that Mr. Sims' chart does not take into consideration the exit gas temperature. Mr. Sims will also agree to that, I am sure, because it was never intended as a chart for the calculation of the efficiency of the boiler unit, rather it is a chart to perform the simple mathematics of calculating the approximate air requirements to burn certain fuels with given overall efficiency, excess air, and output, but without correction for combustible loss, moisture in air, furnace infiltration, duct leakage, or tolerances for fan selection.

I agree with Prof. Leonard that Mr. Darnell's combustible loss calculation is incorrect. The unburned carbon expressed in lb. per lb. of dry coal should be 0.00585 instead of 0.585, and this would then be 0.00567 carbon per lb. of coal as received. The heat loss would then be: $0.00567 \times 14{,}600 = 82.7$ B.t.u. or $82.7/14{,}688 = 0.564$ per cent heat loss instead of 0.30 per cent; and that isn't quibbling, because Mr. Darnell's equation is wrong!

Perhaps Prof. Leonard is quibbling on the meaning of words when he insists that the theoretical air is unaffected by carbon loss, but Mr. Darnell is confused in trying to correct the wording. The weight of theoretical air per pound of coal *burned* is unaffected by carbon loss, but the weight of theoretical air per pound of coal *fired* is affected by carbon loss, unless, of course, the words "theoretical air" in the opinion of Prof. Leonard presupposes no carbon loss.

Finally, I cannot agree that Mr. Sims' chart is wrong, misleading, or useless simply because it does not include a method of calculation for the effect of exit gas temperature on overall efficiency. I do not know Mr. Sims nor have I had correspondence with him, but I feel sure that he assumed that anyone interested in using his chart would first determine a reasonably correct value for the efficiency; this might be known, assumed, or calculated. I also cannot agree that 85 per cent efficiency is *impossible* with 65 per cent excess air because I contend that Mr. Sims had a right to assume that his expression "per cent efficiency of boiler" could also mean efficiency of boiler unit, including a water cooled furnace and other heat recovery equipment.

Chappaqua, N. Y. W. S. PATTERSON

Mr. Leonard to Mr. Darnell

I WISH to apologize for one error. You are correct in the value of 0.375S instead of my value of 0.296S. However, the form of my equation with this correction is still different than the one of Mr. Bato, therefore I am submitting my derivation for your criticism. It would be much appreciated by me if you would do so. If you think I should make public this error, as above mentioned, I will be glad to send a copy of this letter to the Editor of The Practical Engineer and Electrician.

$$\text{Max } CO_2 \text{ per cent} = \frac{CO_2}{CO_2 + (\text{theoretical air})\ 0.7685 + SO_2}$$

$$\text{Max } CO_2 \text{ per cent} = \frac{\dfrac{3\ 2/3C}{44}}{3\ 2/3C + (11.52C + 34.56\ (H\text{-}0/8) + 4.32S)\ \dfrac{0.7685}{28} + \dfrac{2S}{64}} \times 100$$

Dividing each term by $\dfrac{3\ 2/3C}{44}$ gives

$$\text{Max } CO_2 \text{ per cent} = \frac{100}{1 + (11.52C + 34.56\ (H\text{-}0/8) + 4.32S)\ \dfrac{0.7685}{28}\left(\dfrac{44}{3\ 2/3C}\right) + \dfrac{(2S)}{(64)}\left(\dfrac{44}{3\ 2/3C}\right)}$$

$$= \frac{100}{1 + \dfrac{11.52C + 34.56\ (H\text{-}0/8) + 4.32S}{3.04C} + \dfrac{S}{2.67C}}$$

$$= \frac{100}{1 + 3.8 + \dfrac{11.4\ (H\text{-}0/8)}{C} + \dfrac{1.42S}{C} + \dfrac{0.375S}{C}}$$

$$= \frac{100}{4.8 + \dfrac{11.4\ (H\text{-}0/8)}{C} + \dfrac{1.795S}{C}}$$

Dividing by 4.8 gives

$$\text{Max } CO_2 \text{ per cent} = \frac{20.9}{1 + \dfrac{3(H\text{-}0/8) + 0.375S}{C}}$$

The derivation follows: the method assumes that the dry gas is made up of carbon dioxide, nitrogen and sulfur dioxide and that the latter is not measured along with the carbon dioxide. I have expressed the different products in units of mols of gas per pound of coal as for instance 1 lb. of carbon produces when burned, 3⅔ lb. of carbon dioxide or $3\frac{2}{3} \div 44$ mols. (See equations above.)

This result differs from Mr. Bato's equation and your simplification by the term "0.375S" being in the numerator instead of the denominator. I agree with you that such small differences shouldn't be considered; and in practical work, the sulfur probably would be neglected entirely. Is this not true, or are there commercial fuels with large enough sulfur content so that the latter would have to be taken into consideration?

Another question on which I would like information is that of excess air. What is meant by the statement, "the fuel was burned with 25 per cent excess air." I have always understood this to mean that in addition to the theoretical air (based on complete combustion) that an additional 25 per cent was supplied, irrespective as to whether or not the fuel was actually completely burned. Anything you give me in regard to this question would be appreciated.

In closing I want to say that I enjoyed your criticism of my article and I hope you will want to take the time to answer this letter.

Stillwater, Okla. C. M. LEONARD

Williams Votes for Automatic Control

HAROLD GETHOEFER's letter in the November issue on the subject of spending money for improvements revives an oft' discussed subject, namely, automatic or manual control? For my money I will take the automatic outfit every time. The effectiveness of automatic control has been demonstrated so conclusively that I wonder at anybody who considers manual control.

No operator ever lived who could control apparatus manually with the rapidity, accuracy and certainty of automatic equipment. Modern control can almost correct a fault even before it occurs. While the operator reads or dozes or engages in some other work, the automatic system remains on the job. Now, please do not accuse me of trying to put somebody out of work by the use of machinery; my plea for automatic control is not on the basis of saving labor but on that of improving operation.

Wingdale, N. Y. SAM WILLIAMS

Keep 'em Firing with N

AMERICA needs to keep firing on the industrial front as well as on the War front—24 hours a day every day. The inspiring production record of American Industry has been made possible by equally inspiring steam generating capacities. New production records can and will be established if we get the most out of our power plants.

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Questions And Answers

Question No. 215

Simplex Pump Piston Sticks at Low Speeds

WE HAVE a single-cylinder vacuum pump, size 5 by 8 by 12. We have been having a lot of trouble with the pump piston sticking, mostly at the end of the stroke, but once in a while in the middle. This usually happens when the vacuum is fairly high and the pump is running very slowly.

We have had the pump overhauled in a machine shop, but it continues to give us trouble. The piston valve seems to get insufficient oil, although we have used it quite freely.

I would welcome any suggestions on the possible cause of this trouble.

Tacoma, Wash. C. E. D.

Question No. 216

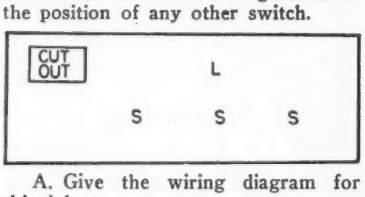
Examination Questions; Who Can Answer Them?

THE FOLLOWING electrical questions were recently submitted in an examination taken by one of our subscribers. He is curious to know how others would answer them. Who wants to try? Published answers will be paid for at regular space rates.

1. Sketch a wiring diagram of a telephone system consisting of two stations about 450 ft. apart. You may use either 1 or 2 wires. Your diagram must be complete and show all batteries and the wiring of each telephone set.

2. List the materials you would expect to find on the job if you were sent out to it to install a 250-hp., 4000-v. wound rotor induction motor. The service into the motor room is 13.2 kv. and enters the room through rigid conduits which are threaded.

3. In the following layout, L represents a bank of lamps and S the stations from which these lamps may be turned "on" or "off" regardless of the position of any other switch.



A. Give the wiring diagram for this job.

B. Write out a requisition for the switches.

4. A. What would you do to protect the wires coming out of a metal sheath cable, insulated for 13.5 kv. from mechanical injury and moisture?

B. How may water be removed from transformer oil?

C. How is transformer oil tested?

D. How would you get the transformer oil out of the drums?

E. You have just installed a bank of three transformers. All the electrical connections are complete. The transformers are oil cooled but have been shipped dry. The oil is in drums.

Tell, step by step, how you would put this bank of transformers into service.

5. A. Explain how you would install 10 lighting fixtures each consisting of four 20-watt fluorescent lamps.

B. What, if any, auxiliary devices are required besides the tubular lamps?

C. How would you increase the power factor of the job installed in question No. 5-A?

6. A room is 10 by 20 ft. There is one outlet in the center of the ceiling which is a flat terra cotta arch on which there is a plaster finish. You are to install two new outlets located 5 ft. in from the end and side walls. These new outlets are to be connected to the existing outlet which is to be blanked. The new work is to be concealed. The existing outlet is a standard 4-in. box.

A. Explain how you would do this job.

B. Prepare a bill of materials for this job.

Question No. 217

Is a 10-amp. Fuse Always a 10-amp. Fuse?

IN PLACING fuses in a circuit what is the difference in the ratings in the 250-v. and 500-v. types, that is, what is the difference in the carrying capacity in amperes of a 10-amp., 250-v. fuse and a 10-amp., 500-v. fuse? Would both blow at the same amperage at either voltage and is the difference in length the only reason for the different voltage rating?

Albert, W. Va. FRED HARTMANN

THERE is no essential difference in the carrying capacity of a fuse rated at 10 amp., 250 v. and one rated at 10 amp., 500 v. Both fuses will blow when a current exceeding 10 amp. passes through them. The voltage rating of a fuse applies only to its insulation value and to the voltage of the arc which it can effectively interrupt.

A fuse rated at 10 amp., 500 v. can be used on a 250 v. circuit, but not vice versa since the arc formed by the blowing of the 250 v. fuse on a 500 v. circuit might not be interrupted in time to prevent damage. It should be obvious that a fuse rated at 10 amp., 250 v. would have difficulty in clearing the arc on a thousand-volt circuit even though the current responsible for rupturing the fuse is no more than 10 amp.

If you will always think of amperage as having nothing to do with the voltage of a circuit as far as carrying capacity is concerned, you should have no trouble in understanding the proper use of fuses.

Answer 197

Dope on Making Templates

W.B.L.'s QUERY regarding methods of calculating or making patterns to mark off pipe in making 45 deg. angles or to join pipes in making branches or wyes brought forth good response. Several of those answering the question show W.B.L. actually how to lay out his pipes, but it seems that all the necessary data he needs is contained in a booklet published by the Linde Air Products Co.

See "Fabrication of Oxwelded Piping"

THE DATA wanted by W.B.L. is available in very complete form in a booklet published by the Linde Air Products Co., 30 E. 42nd St., New York City, entitled "Fabrication of Oxwelded Piping" and we believe can be obtained free of charge.

Outside of a considerable amount of valuable information covering all phases of pipe fabrication by cutting and welding, methods are described for the layout of pipe cutting templets, to be used in the fabrication of 90 and 45 deg., wye branches and also for 90, 60, 45, 30, 22½ and 15 deg. single weld turns. For the 90 deg. branch and the single weld turns listed, lengths of the templet ordinates for pipe sizes 2 to 36 in. inclusive are tabulated, eliminating the necessity of making a complete scale layout of the fitting in order to obtain the correct length of these ordinates.

To make the 'stove pipe' type welds W.B.L. refers to, 90, 60, 45, 30, 22½, and 15 deg. templets can be used in any combination depending on the included angle and the radius of the turn to be manufactured.

Outside of this information, the layout and manufacture of 'orange peel' pipe closures and concentric and eccentric swadged reducers is also described in detail.

Marcus Hook, Pa. H. C. R. FOLMER,
Corporation Engineer
American Viscose Corp.

Use of Soap Solution

THE LINDE AIR PRODUCTS CO. offers a free booklet, "Fabrication of Oxwelded Piping" in which is clearly explained and sketched methods of laying out templates for all kinds of pipe joints as well as considerable other valuable information. Here is a tip. If a piece of pipe is dipped in any soapy solution at the desired angle a ring of the solution will remain on the pipe for cutting the

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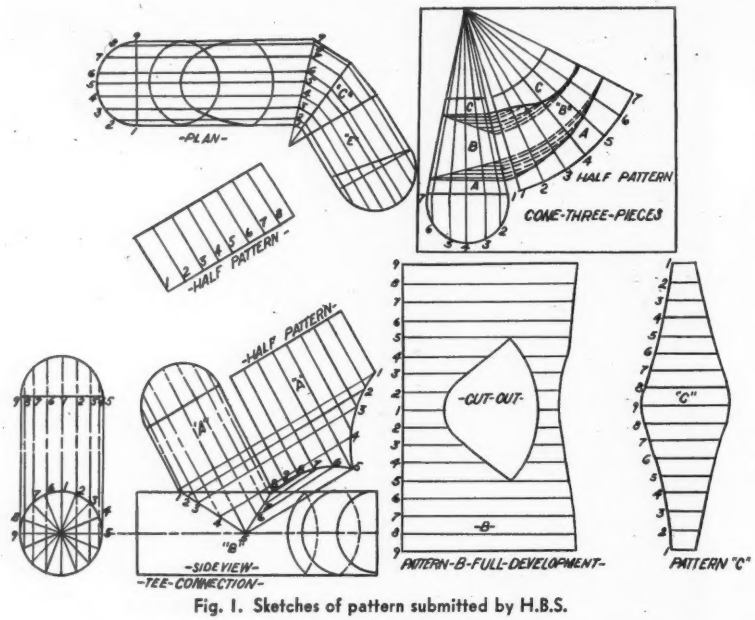

Fig. 1. Sketches of pattern submitted by H.B.S.

guide lines. This method is quicker and just as accurate as any template.

Buffalo, N. Y. R.L.S.

Sketches for W.B.L.

RELATING to W.B.L.'s question 197 on p. 101 of the November issue, the sketches in Fig. 1 indicate how a tee pipe connection should be laid out, and also how a truncated cone can be laid out.

Inasmuch as the question asks how to lay out an elbow, it will be noted that pattern 'C' would be the template that would be used for section 'c,' as indicated in the sketch.

It is understood that no allowance has been made for lap, if of riveted construction, and it should also be observed that in the case of heavy pipe, it would be necessary to make the proper allowance for rolling of the material; otherwise after the patterns are rolled they will be of smaller diameter.

Of course, different shapes of patterns could be designed for the cone or tee connection, this depending where it is desired to place the seam of the vessel; for example, in pattern 'A' of the tee connection, it will be discerned that the seam would come at the point marked '1'.

The wye connection can be laid out similar to the tee connection, as shown in the drawing.

Pittsburgh, Pa. H.B.S.

A Simple Graphical Method

1. DIVIDE one-half of the outside of the pipe circumference into a number of even parts. 2. Project the points on the circle to the base of the right angle triangle shown below. 3. At the right lay off the horizontal line into 16 equal parts to correspond with the divisions on the circle and then by means of a pair of dividers or by projection locate the points on the curve to correspond to the heights of the vertical lines on the triangle. Draw a curve through these points to get the required pattern. Wrap this pattern around the pipe and with a piece of soapstone you can trace the curve on the pipe itself.

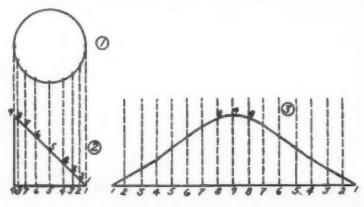

Fig. 2. George Deichmann's scheme for layout of pipe patterns

New Orleans, La. GEORGE DEICHMANN
Falstaff Brew Plant No. 4

Answer 199

Should He Raise His Condenser Pressure?

THIS question was asked by E. B. on p. 101 of the November issue. He was operating a 16-t. 2-cylinder ammonia compressor at 140 lb. condenser pressure and 20 lb. suction pressure. Condenser water entered at 45 deg. and left at 80 deg. He used considerable water and he wondered whether he could save water by raising the condenser pressure to 180 psi. The question resulted in a considerable response as the letters below will indicate.

It Depends on the Capacity of His Compressor

WITH so little information and so many variables it is difficult to give a definite answer, but the following information may solve E. B.'s problem.

Water entering at 45 deg. F. and leaving the condenser at 80 deg. F. will pick up 35 B.t.u. per lb. The total water consumption under this condition will be

$$\frac{288{,}000 \times 16}{35 \times 24} = 5485.7 \text{ lb. per hr.}$$

At 180 psi discharge pressure a 50 deg. F. rise can be allowed which brings the temperature of the water leaving the condenser up to 95 deg. F. Thus the water picks up 50 B.t.u. per lb. Now the water consumption will be

$$\frac{288{,}000 \times 16}{50 \times 24} = 3840 \text{ lb. per hr.}$$

which gives a saving of 1645.7 lb. per hr. or 30 per cent.

In the meantime changes will take place as far as power to the compressor is concerned. With a suction pressure of 20 psi and a discharge pressure of 140 psi, the ammonia will absorb 613.5 — 132.7 or 480.8 B.t.u. per lb. The total amount of ammonia circulated is

$$\frac{288{,}000 \times 16}{480.8 \times 24} = 399.3 \text{ lb. per hr.}$$

If the condenser pressure is raised to 180 psi by using less water the heat absorbed by the ammonia will be 613.5 — 149.9 = 464.6 B.t.u. per lb. Under this condition the amount of ammonia needed will be

$$\frac{288{,}000 \times 16}{464.6 \times 24} = 413.3 \text{ lb. per hr.}$$

or an increase of 14 lb. per hr.

These values are given in order to show that a greater pressure differential brings about a greater amount of ammonia to be circulated for the same refrigerating effect. If the size of the compressor plus the mean effective pressures were available the answer would be definite as far as power increase is concerned, but according to values from ammonia table on theoretical horsepower per ton of refrigeration an increase of 25 per cent in power takes place in raising the pressure from 140 psi to 180 psi.

If E. B. runs his cooling water to waste he can take 30 per cent off his cost of water and add 25 per cent to his power bill which will give the answer.

If a cooling tower is used it seems inadvisable to cut down on water as higher pressure puts more strain on his equipment and maintenance cost will go up plus the cost of a smaller pumping unit.

San Francisco, Cal. GUNNAR SPILLUM

It Depends On Costs of Various Commodities

IN ORDER to give a broad and at the same time brief answer, I have made a tabulation applicable to E. B.'s single-acting compressor operating at 20 lb. suction and 105 to 205 lb. condensing pressure. The table is on p. 104.

Operating at 140 lb. condensing pressure and water leaving condenser at 80 deg. F. (as stated in the question) indicates the water temperature to be the same as the ammonia temperature corresponding to the condensing pressure, and is assumed in the table. I have also assumed that the liquid ammonia is not sub-cooled. Columns 10 and 11 include jacket cooling water.

The most economical condensing pressure depends on the cost of water and power, refrigeration requirements and to some extent on operating conditions. In columns 12 and 13 I have assumed water to cost 10 cents per 100 cu. ft., and power 1 cent per hp.-hr. The most economical condensing pressure would be approximately 155 lb. as indicated in column 14. E. B. can apply his known costs of

A Report on The Steel Valve Outlook

"What's the 1943 delivery picture for steel valves?"
"How can I get quicker shipment?"
"How long am I going to be able to get repair parts?"
"How will valve material substitutions affect me?"

Culled from the mail, these are the kind of questions which prompt this simple, straightforward report on the wartime activities of The Edward Valve & Mfg. Co., Inc.

Here are the facts.

What About Deliveries?

War needs for steel valves have, of course, increased during the past year. Nevertheless we have tried not to bite off more than we can chew. We have tried to set delivery schedules based on facts, not hopes.

Since critical materials are used in the manufacture of steel valves, limitation orders, directives and revised preference ratings have occasionally resulted in minor delivery changes, but *on the whole, we have been ahead of schedule throughout the past year.*

During 1943 we intend to follow a similar policy. We are serious about keeping or bettering delivery promises.

How About Repair Parts?

When a valve user orders a repair part he usually needs it in a hurry. Therefore we put particular emphasis on delivering parts quickly. *At the close of 1942 there was not a single past due repair part order on our books.*

Orders for maintenance parts are naturally increasing since old equipment must last for the duration in many plants. To help keep these plants running we will continue to give preferred treatment to repair part orders, within the limitations of government regulations, of course.

Simplification Cuts Inventories, Speeds Shipment

The war has brought much voluntary valve standardization and simplification. The user, the distributor and the manufacturer are all gainers.

For years Edward engineers have designed for maximum part interchangeability. As a result, *Edward users today need only small inventories of replacement parts.* The new Edward INTEX valves are a case in point. Only a few simple tools are required for maintenance, and parts are unusually accessible and highly interchangeable. Inexperienced men and women can maintain and operate Edward valves.

Equally important, elimination of "specials" makes possible quantity manufacturing and speeds deliveries. Stick with the standard and you'll get your valves much quicker.

Certain valve types and pressure groupings have been discontinued to free additional war production capacity, but *Edward still builds a complete line of steel valves for all land and marine service temperature and pressure conditions.* Edward sales representatives are experienced valve engineers. Edward valves are also available through leading industrial distributors the country over, with the full assistance of factory engineering and sales staffs at their disposal.

War Materials and War Workmanship

The materials going into Edward valves today are just as good or better than before the war. Actually, very few material substitutions have been required.

Edward workmanship standards, too, are unchanged. Naturally, with a greatly expanded personnel new supervisors have been created, but virtually every new department head or foreman has been promoted from the ranks where he has had imbued in him the Edward principles of closely controlled workmanship. The addition of much new precision equipment makes adherence to Edward standards even more certain.

Post-War Plans

In the Edward laboratories and design departments, an uninterrupted development program is carried on, pointing the way to new refinements, new products, and new post-war applications.

Since our plant is occupied entirely with the manufacture of standard Edward steel valves there need be no time out after the war for reconversion to peace-time valve production. Further, the Company is a closely integrated organization—a single unit complete in one location—making it relatively easy to change to meet changing conditions, yet making possible rigid quality control.

* * *

The only thing certain about the future is that it will be full of change. Undoubtedly many of your problems and ours will be mutual ones. And whether we are able to meet your valve needs or not, we'll be happy indeed to work with you on any matters concerning the procurement, use, maintenance or development of cast and forged steel valves.

W. F. Crawford
President

The Edward Valve & Mfg. Co., Inc.

Cast and Forged Steel Valves — East Chicago Indiana

Table Compiled by Mr. Ray

Condenser gage press. and corresponding liquid ammonia temp.		Engine or Motor hp. required for compressor		Refrigeration capacity of Comp. Tons in 24 Hr.	Ideal Temp. of Compressor Discharge, and Heat Content B.t.u./Lb.		Heat Content of Liquid Ammonia B.t.u./Lb.	Heat Absorbed by Cooling Water Tons Refrig. 24 Hr.	Water required Temp. Enter 45F Temp. Leave Same as Ammonia Temp. Corresponding to Condenser Pressure		Cost of Water Per Day at 10c Per 100 Cu. Ft.	Cost of Power Per Day at 1c Per hp. Hr.	Total Cost of Water and Power
		Per Ton	Total		Temp.	Heat			Cu. Ft. Per Ton	Cu. Ft. Per Day			
105	65.7F	.936	16.	17.1	158F	687	116	18.7	222	4151	$4.15	$3.84	$7.99
125	74.3	1.094	18.	16.5	180	698	126	18.3	158	2891	2.89	4.32	7.21
145	82.	1.246	19.9	16.	200	708	135	17.9	124	2220	2.22	4.77	6.99
165	89.	1.405	21.6	15.4	218	717	143	17.7	105	1858	1.86	5.18	7.04
185	95.5	1.563	23.4	15.	235	725	150	17.1	91	1556	1.56	5.61	7.17
205	101.4	1.72	24.9	14.5	249	732	158	16.7	82	1369	1.37	5.97	7.34

water, power and operating requirements to the table and determine his most economical condensing pressure.

Los Angeles, Cal. REMBERT RAY

Answer 204

He Wants Advice on Firing His H. R. T. Boiler

INASMUCH as the first comments on this problem repeat the original questions, we give them and the answers forthwith.

Size of Grates, Furnace

IN REPLY TO Cloyd C. Cahill's questions in the December issue, we readers will do all we can to help along.

His first question: What would be considered the proper distance from the grates to the boiler shell in a 72 by 18 h.r.t. boiler, (a) for hand firing, (b) for stoker firing?

Answer: In the setting of h.r.t. boilers, the Hartford Steam Boiler Inspection & Insurance Co. recommends certain distances from the grates to the boiler shell and from the top of the bridge wall to the shell, and the distances vary with different kinds of fuel used, as follows:

From grate to shell with bituminous coal having more than 35 per cent of volatile matter, 44 in. With bituminous coal having from 18 to 35 per cent volatile matter, 40 in. With semi-anthracite and anthracite containing less than 18 per cent of volatile matter, 36 in.

Question 2. How high should the bridge wall extend above the grates?

Answer: The bridge wall should extend about 22 in. above the grates on this type and size of boiler, with hand firing. With stokers it's a different story. To get the proper stoker and furnace for a boiler of this type and size, all information should be sent to the manufacturer and he will advise the correct size.

Question 3. What should be the grate area for a boiler of this size?

Answer: The grate area differs, some engineers seem to feel that the width of grate should be the same as the diameter of boiler, in this case 72 in. The length should be 72 in. While others differ on these sizes, still most agree with the width but not the length. I would say with his size boiler and working pressure, 125 psi., the width should be 72 in., but the length 60 in., thus giving an area of 30 sq. ft.

Question 4. Would changing from sloping grates with wide dump grate in the rear (used previously for coking process, but steam demand is now too great for this method of firing) to horizontal grates increase the steaming capacity?

Answer: In this question, I believe most engineers will agree that the increase in capacity will be more with the type of grate now in the boiler (sloping). More than likely, the type of stoker Mr. Cahill has is a hand-operated mechanical stoker. If it is, I would let it stay the way it is rather than change to horizontal grates.

Philadelphia, Pa. T. F. CUNNINGHAM

The Mystery of the Two Vats

(Continued)

A few left-overs from last month's red hot problem contest with particular emphasis on the ex-editor's solution

LAST MONTH, in our analysis of the mystery of the case of the two vats, we reported the fact that among the numerous solutions submitted there was one from our ex-editor-but-now-in-the-air-force-Morris. His solutions, for he sent several (apparently he has very little to do in the air force), were not without merit if we could only have read them. The Army needs typewriters, so we are told; well, if any of you patriotic readers have one to spare, please send it to Dick Morris—we will see to it that you receive a certificate of meritorious achievement or something. He has a fountain pen but it is quite obvious that he has not the slightest idea of how to use it.

We knew that the hen scratching he sent to us was intended as a solution to the vat problem because he attached a clipping of the original statement of the problem and some diagrams. Our cipher expert is at present on leave with the intelligence service so we could do little with it at the time except to mention the fact that the ex-editor had submitted a solution. This apparently was not enough for in a letter to another member of the editorial staff he delicately consigned the Contest Editor to a well-known hot spot.

This, naturally, hurt the Contest Editor's feelings and he forthwith made a resolution to translate the hieroglyphics and determine whether the ex-editor's implication that the judges' decisions are cockeyed, was valid or not. It was not.

Within the limits of our translating ability the following is a more or less accurate if somewhat incomplete transcription of the solution in question. We quote—

"Our Hero's not in such a tight spot as he thinks. He can solve it quite simply, or if this military stuff is not the bunk and he has oodles of money to spend he can make it as expensive and comprehensive as he likes." (Ed. Note: Note the government-spending angle.)

"First the proportioning of the flow; he could put in a layout of proportional controllers. If that's too expensive he could buy or have made two orifices and substitute them for the present valves A and B. Both of these orifices are subject to the same pressure variations and the relative size of the two could be calculated with fair accuracy without a great deal of trouble. If it is not hit right on the head the first time, a few trials and a bit of elbow grease and a file will do the trick so that both tanks fill in the same time.

"He would, of course, have to add an extra valve so that the flow to both tanks could be turned on and off together and so that the pressure on both lines would be the same. A pump governor would help the pressure probably but would add little to improve the proportioning of flow because the pressure variations affect both orifices the same.

"If Our Hero is Scotch and does not mind a little experimenting he could add a valve in the main feed to the two lines to the vats, then close valve B about a third and then play around by throttling the valve A until the flow through that line was half the flow through B. Both lines should then be locked in position and used like the orifices. Substituting two plug valves or cocks for the valves A and B would give even better results with less danger of having them moved accidentally and the adjustment lost.

"If Our Hero wants something reasonably fancy he could add two solenoid operated valves so that the

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Without your help, we could not have gained the high honor of the Army-Navy "E" production award. Your co-operation permitted us to produce the valves it took.

More than 3,000 go into every battleship. How many do you think are needed to build America's *two-ocean* Navy? The ever-growing Liberty maritime fleet? How many thousands more for barracks, cantonments, and plants turning out Army equipment?

Doubled and re-doubled were our facilities beginning even before the war. Yet, only because you helped, were we able to meet the vast demands for Crane valves.

You made that possible by conserving the valves installed in your lines—by giving them the best of care—by *"making them do"* in the face of critical materials shortages. And most likely, as so many plants are doing, by utilizing the valuable tips in Crane "Piping Pointers" Bulletins on getting better and longer service from piping equipment.

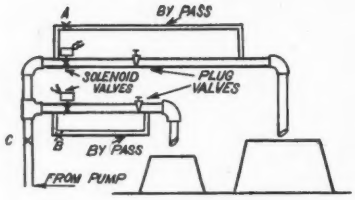
As a result, on both industrial and fighting fronts, more and more Crane valves are today quickening the pace of America's march to Victory—assuring dependable flow control of every vital fluid.

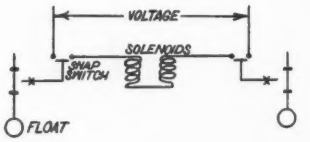
And here at Crane, the Army-Navy "E" is spurring us on in making even more valves—helping us get our part and your part of this wartime job done faster.

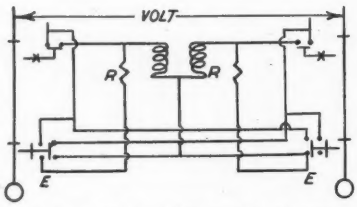
Crane Co., 836 South Michigan Ave., Chicago, Illinois

"Piping Pointers" Bulletins—one of Crane Co.'s wartime aids to industry for getting better and longer service from valves. Supplied free on request.

CRANE VALVES







Figs. 1, 2 and 3. The ex-ed's schemes in diagram form

operator could watch the blonde with one eye, keep the other on the tanks and do the controlling with push buttons. It would be best to substitute plug valves and use the present valves A and B in by-passes around the solenoid valves so either tank could be filled independently if desired. This is shown by Fig. 1.

"Having gone that far he might as well make it automatic so the guy can give all his time to the blonde. He can do this by adding a float well (with a float, of course) in each tank. The obvious thing would be to use one solenoid valve at C with the two float switches in series so that the valve would open only when both switches were closed. The solenoid valves should be arranged so as to close when the circuit is dead so as not to flood the place if the power went off.

"However, he already has two valves so hook them up as shown by Fig. 2 (keeping in mind that they are in series and require twice the voltage). The dogs on the float valves can be adjusted as needed. This works fine as long as the two levels stay together. When they don't one tank gets full and the other one empty and the valves chatter; the boss swears and everything stops.

"It is not difficult to fix the circuit so that after the circuit is closed and both valves open together, each solenoid valve stays open until its own float switch trips. Thus, both tanks would fill to the desired level each time. A simpler method is shown by Fig. 3. The two tanks are brought to the same level each cycle at the bottom rather than at the top and there is positive protection against overflowing. Also if a light be substituted for the resistance R it serves as a warning to the operator that the two tanks are not staying together and he can correct the condition by means of the by-pass.

"If one tank empties fast the float trips the snap switch, but nothing happens because the other float is not down. Ordinarily the first tank would probably empty before the second tank level came down and opened the valves. This, however, is prevented by the contact switch E. If, after the snap switch operates, the level keeps dropping, the dog contacts energizes the solenoid valve and the tank starts to fill up. As soon as the level comes up the circuit opens and this continues until the second tank level drops and both valves open. The adjustments can be made as close as conditions require.

"Thus, both tanks fill together, neither can overflow, neither can run empty, and if the proportioning gets out of adjustment the levels are made to coincide each cycle and the operator is warned that something is wrong and that the blonde had to watch out for herself for a few minutes.

"Cost. Two solenoid valves, two plug valves, one gate valve, a bit of pipe, two float valves and four snap switches."

Signed: Richard H. Morris.

Well, there it is readers. Not bad for an ex-editor, is it? Now that we see it here in print, we feel better (or worse) about it and maybe it should have been awarded some sort of a prize. However, we can find plenty of technicalities on which to condemn it. For example, his terminology is poor. He continually refers to the vats as tanks. This is a grave error and it alone suffices to disqualify it. Secondly, the letter originally ran to exactly 1002 words. (The version presented here is condensed.) The rules of the contest called for a letter of not more than 1000 words so this is the second reason for disqualifying the letter. Thirdly, the letter reached us the day after the contest officially closed; that makes three counts against it. Finally, we could not read it. Still after all is said and done it is a pretty good letter and gives Our Hero many good suggestions.

Now, let us turn to some of the other letters received on which we could not comment in the analysis in the January issue. One, which rather intrigued the judges was the one submitted by C. Bertelsen of Brooklyn, N. Y. His letter is short, but he submitted the diagram shown in Fig. 4, which is self explanatory. "The flow can be regulated," says Mr. Bertelsen, "by installing a tipping device designed so that one side has twice the capacity of the other side. Stopping and starting can be done by an ordinary float."

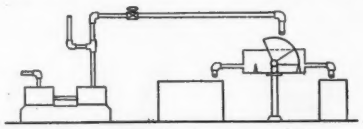


Fig. 4. Bertelsen's arrangement

This is an ingenious solution, but it fails to adhere to the requirement that both of the vats fill at the same time. For certain purposes an arrangement such as this might have advantages.

John R. Kelly, assistant superintendent, and Bill Crow, operator, at the plant of the City of Gainsville, Florida, propose a rather unique way of regulating the flow. This scheme is shown in Fig. 5. Their letter follows:

"Vat No. 1 has twice the capacity of vat No. 2 yet both vats must be filled simultaneously. This was accomplished before by manually operating valves A and B.

"The problem is of course to improve on the filling process of the two vats. This can be accomplished by making a few changes in the piping, using a governor C, pressure reducer E, gate valve D, and by eliminating valves A and B. As the demand on the 'other service line' changes the governor C keeps a constant pressure on line filling the vats. Pressure reducer E reduces the water pressure so water will flow freely out of the upturned pipes over vats 1 and 2 without a geyser or spraying action.

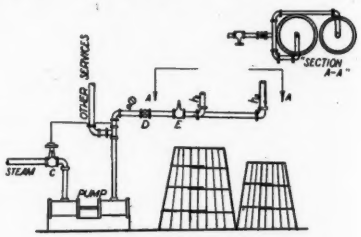


Fig. 5. Kelly and Cross

"H_1 and H_2 are so made that the total head H_2 equals twice total head H_1, thus flow into vat 1 equals twice the flow into vat 2 all other factors being the same.

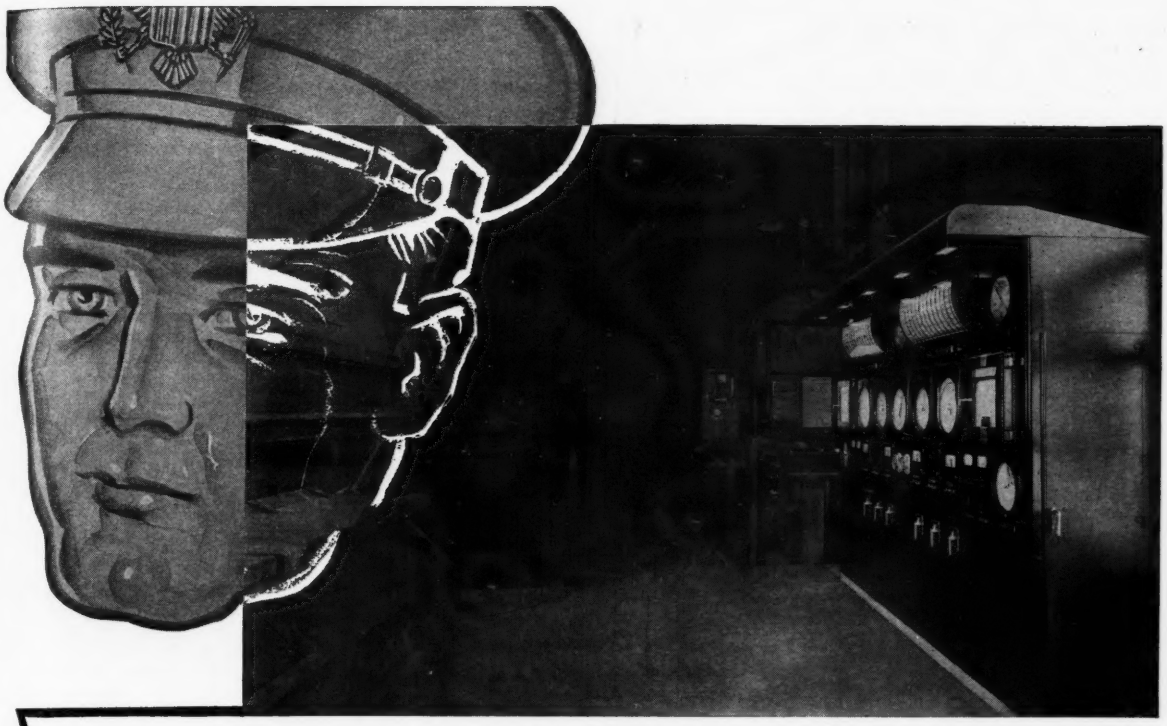
"Of course if the blondes still bother the operator we recommend either that a float control valve be inserted between valves D and E or that an older operator be hired."

Make careful note of the suggestion made in the last paragraph of their letter—that an older operator be hired. Boy! that would only make the situation worse. The older they are the worse they are. Thumbs down on that idea.

As indicated in our analysis of the problems presented last month, there were many contestants who made use of an intermediate storage tank between the pump and the two vats. One version of this idea is shown in Fig. 6, submitted by P. M. Van Wingen. Quoting from his letter:

"My solution is very simple and yet very effective because it is not at all affected by the pressure on the pump discharge due to other equipment being connected to the pump, and also because the condition of divided flow has been entirely eliminated.

"As shown in the diagram, the



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pump is allowed to discharge into the overhead tank "A" which is equipped with a float valve B. This valve will keep the tank supplied with water and will shut off the supply automatically when the tank is full. Water is allowed to drain out of the head tank through the two pipes C and D into their respective vats E and F. Since vat E has twice the capacity of F, pipe connection C should be approximately twice as large in area as D. Globe valve G is put in the line so that by trial it may be set so that the flow through C will be twice that through D. This setting can be very easily determined after a few trial runs.

"Thus it can be seen that the head on both pipes will always be the same and that there is no condition of divided flow so therefore the flow in the two pipes will always be in a ratio of 2 to 1, no matter what the load conditions are on the pump. The effect due to the differences in entrance losses and fluid friction in the two pipes, although inconsequential can be entirely eliminated by the globe valve setting.

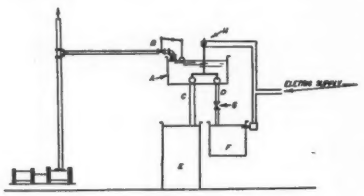


Fig. 6. P. M. Van Wingen

"The solenoid operated valve assembly H is shown diagrammatically only, but the mechanical details could be very easily worked out. The purpose of this valve assembly is to automatically shut off the supply to the two pipes when the upper level has been reached in each tank. This level, of course, as stated in the problem, must be reached simultaneously in both tanks. When the upper level is reached the electric level controller trips the solenoid circuit, releasing the two valves and shuts off the water in the pipes.

"This simple scheme is entirely fool-proof and fully automatic, made up of parts with which every practical man is familiar and does not require any elaborate instruments to cause trouble in adjustment."

Along similar lines but attaining his object in a slightly different manner is the scheme of G. F. Suchy shown in Fig. 7. He also uses an intermediate tank, but in this case it is a weir box. The arrangement is well worked out and probably would work, but of course, as pointed out in the analysis in the January issue, it might not be convenient to erect such a weir box above the vats. "The weir box," says Mr. Suchy, who lives in West Fargo, N. D., "is supported above the vats.

"Two rectangular weirs are shown on one side of the box. However, if the vats are far enough apart the arrangement could have one weir on each end

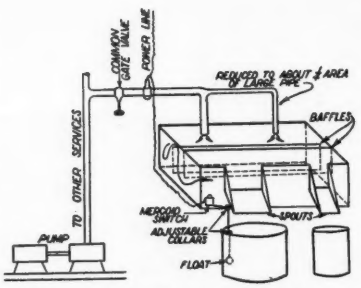


Fig. 7. Suchy weir box arrangement

of the box with slight alterations of the inside partitions. If the formula

$$Q = 3.33Lh^{\frac{3}{2}}$$

is used then the larger weir would be exactly twice as wide as the smaller. Both should be the same distance from the bottom and the box must be maintained level. If both vats become empty at the same time, then only one small float would be required as shown in the sketch. The sliding stem on it would have two adjustable collars which would open or close a mercoid switch according to depth of liquid required in the vats. The mercoid switch would open or close a solenoid valve on the supply line. Since there would be some afterflow when the solenoid valve closes, the bottom collar on the sliding stem would be adjusted to prevent overflow of the vats.

"If both vats do not become empty at the same time, then a float with mercoid switch would be installed in each vat. The two mercoids would be connected in series so that the solenoid valve will not open until both vats are empty.

"The size of the box and weirs would have to be estimated according to maximum possible flow delivered by the pump when the other service line is shut off. The reduced second pipe outlet would, together with the partitions in the box, insure an even head on the weirs so that the flow could be divided exactly as required."

Summing up, it must be said that there were very few letters that did not have one or two good suggestions to offer in helping Our Hero solve his problem. Most of the solutions easily fell into three different classes. First there was the orifice type of solution; second, the intermediate storage tank or weir box class and third, the proportional flow or regulator type of solution. There were a few with more or less complex link motion arrangements which did not fall into these classifications, but in general they took one of the three forms described above.

It is always interesting to see how different men solve these problems. Some are very practical, others are more theoretical; some are exceedingly detailed and are accompanied by well executed drawings, others are content to submit their ideas with merely a rough sketch. The letter sent in by W. J. Taylor of The Steam Plant Equipment Co. in Milwaukee, Wis., was of interest to us because it shows how a manufacturer's representative thinks about these things. He made use of the orifice method, but was exceedingly detailed in specifying the size of every fitting and pipe used in the system. Since his letter is so detailed, we present his recommendations below. He groups them into four paragraphs as follows:

1. Install a constant pressure pump governor in the steam line to the pump with a ⅜ or ½-in. control line between the diaphragm and the pump discharge line (install a needle valve in the control line to dampen out the hydraulic surges and obtain smooth pump operation). Adjust governor to maintain 60 to 75 lb. pump discharge pressure, or higher if necessary for "other service line."

2. Install a suitable size water line to each vat if they are not now of proper size based on reasonable pressure drop characteristics.

3. Install a suitable size orifice plate in each hot water line to the two vats to maintain a 2 to 1 flow ratio since one vat has twice the storage capacity of the other vat, yet both must be filled during the same period of time. Use a gate valve in each water line about 20 pipe diameters ahead of the orifice plates, accessible from the operating floor or platform for emergency shut-off service. Care should be used to keep these gate valves wide open except when shut-off service is required.

4. Install a single-seated ball float valve in each vat with the discharge line extending down to within about 8 to 10 in. of the bottom of the vat to prevent turbulence when the water level reaches the ball float. If sludge accumulates in the bottom of the vat then extend the pipe only 18 to 20 in. below the float valve. Use an 8 in. diameter ball float on 1½, 2, 2½ and 3 in. size float valves and a 10-in. diameter ball float on 3½ and 4 in. size float valves. Where a 6-in. or larger regulating valve is required it is advisable to have this pilot operated for smooth control, using water or compressed air as a pilot medium. Some engineers prefer a direct operated liquid level controller and in that case a float box should be installed outside of each vat to operate a lever valve in the water lines. A single-seated regulating valve is desirable for tight shut-off to prevent overflow of the vats, but this type of valve is not recommended for large float valves having the float and rod directly connected to the valve stem where the water pressures are high since chattering may result due to excessive unbalanced pressure on the valve disk and stem. A single-seated internally pilot operated lever valve is available for this service on some applications.

Mr. Taylor closes by pointing out that an established manufacturer or his field representative specializing in fluid controls can readily make specific recommendations for this installation after being given all necessary data for thorough analysis.

*July, 1941—1,700,000 B.H.P.
*Dec., 1941—2,000,000 B.H.P.

Ordered for more than

2,800,000*

boiler horsepower

No other steam-flow type feed water regulator has ever been accepted so widely, so quickly. You will find installations of the COPES Flowmatic Regulator now in service or on order:

★

In 34 states and in 11 other countries—on 4 of the 5 continents.

★

On B. & W., Badenhausen, Bigelow, C-E, Edge Moor, Erie City, Foster Wheeler, Freyn, Riley, Springfield, Union, Vogt, Wickes and 10 other makes of boilers.

★

On boilers operating at pressures of from 80 to 1900 pounds gage.

★

On boilers having capacities from 15,000 to 550,000 lbs. per hour.

To be specific . . . in little more than four years, the COPES Flowmatic Regulator has been ordered for 749 boilers with a total steaming capacity of 98,315,476 pounds per hour. And for good reason. The COPES Flowmatic gives remarkably close water level control . . . usually within plus-or-minus one inch . . . regardless of boiler design, pressure or load conditions. Yet the design is so mechanically simple, the construction so rugged, that no more than routine servicing is needed. For complete information on this two-element steam-flow type regulator, write for Bulletin 429.

NORTHERN EQUIPMENT CO., 232 GROVE DRIVE, ERIE, PA.

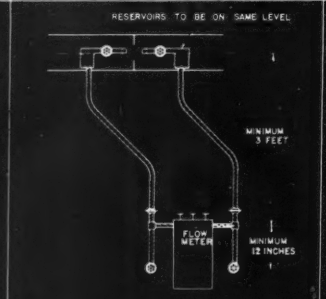
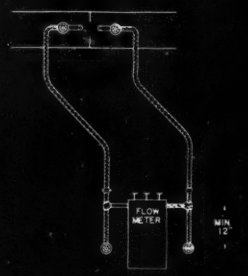
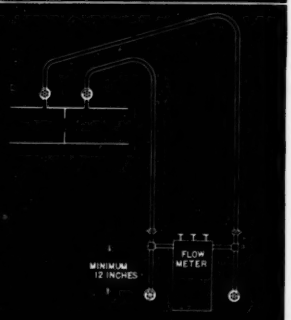
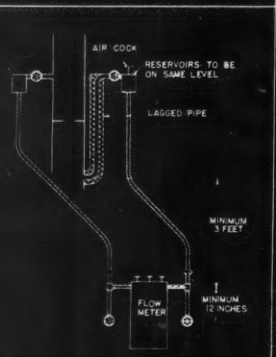
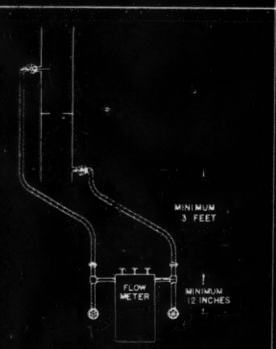
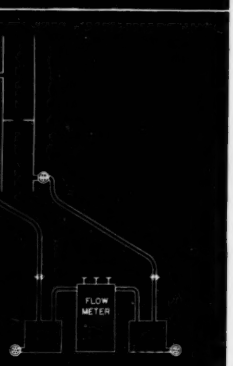
Feed Water Regulators, Pump Governors, Differential Valves
Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS IN CANADA AND ENGLAND. REPRESENTATIVES EVERYWHERE

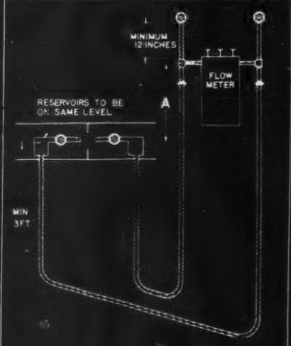
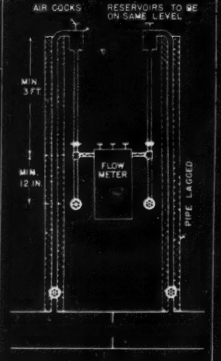
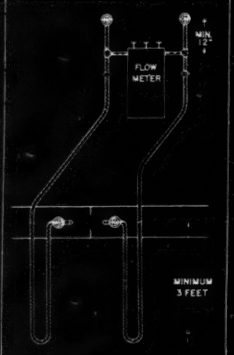
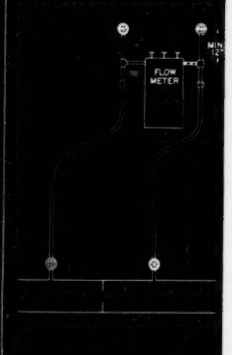
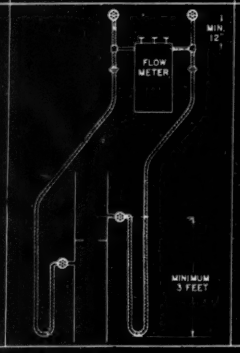
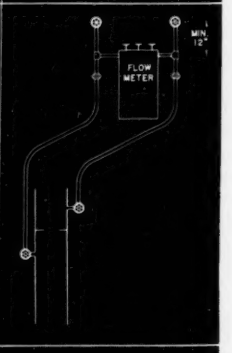
★ GET CLOSER LEVEL CONTROL WITH THE FLOWMATIC ★ REGULATOR

PIPING ARRANGEMENTS FOR METER INSTALLATION

METER BELOW PRIMARY ELEMENT

	STEAM	WATER	AIR OR GAS
HORIZONTAL			
VERTICAL			

METER ABOVE PRIMARY ELEMENT

	STEAM 25 LBS. AND ABOVE*	STEAM BELOW 25 LBS.	WATER	AIR OR GAS
HORIZONTAL				
VERTICAL	NOT RECOMMENDED			

THIS FULL PAGE OF DETAILED DRAWINGS WAS PREPARED AS FIG. 2 OF THE ARTICLE THE WHY, WHEN, WHERE AND HOW OF FLOW METER INSTALLATION BY W. C. BENNETT WHICH APPEARS EARLIER IN THE PRACTICAL ENGINEER & ELECTRICIAN SECTION OF THIS ISSUE.

TUBING MUST SLOPE AT LEAST ONE INCH PER FOOT

*DIMENSION A IN FEET MUST PROVIDE STATIC HEAD TWICE AS GREAT AS MINIMUM STATIC PRESSURE MINUS MAXIMUM DIFFERENTIAL PRESSURE

Diagnosis and preventive measures are not limited to the activities of the medico. The Betz organization has been applying these principles in the field of industrial water conditioning for many years . . . and the results obtained have borne out the soundness of a scientific approach.

Water, which can truly be called the common denominator of all industry, is seldom suitable for use in its natural state. It is our function to assume the responsibility for protecting industry from the many hazards which accompany the use of incorrectly or inadequately conditioned water for boiler, cooling, and process uses . . . and in the handling of problems of industrial waste and sewage disposal.

We have laboratories and engineers located throughout the United States and Canada.

W. H. & L. D. BETZ

FRANKFORD • PHILADELPHIA • PENNA.

CHEMICAL ENGINEERS AND CONSULTANTS ON ALL WATER PROBLEMS

POWER PLANT INDUSTRY MEETS 1942 WAR DEMANDS

(*Continued from page* 86)

Two identical transformers, the biggest in the company's history, were built to handle power for a new aluminum plant, step up voltage from 27,000 to 132,000 v. to provide most efficient transmission between a generating station and the aluminum plant. The transformers required about 188 tons of structural steel, 111 tons of special core steel and 130 mi. of copper wire weighing 29 tons.

Substitutes for Strategic Metals

Their construction would have required 40 tons more of steel and 4 tons more of copper if they had been built prior to the recent development of a new core steel, Hipersil, which carries one-third more magnetic flux than any steel previously used for transformer coils.

During the past 12 mo. many substitutions of materials in electrical apparatus were made to conserve metals urgently needed for other tasks. For example, Hipersil steel was substituted for a nickel alloy in the manufacture of the Ignitron rectifier, conserving 20,000 lb. of nickel, enough to make armorplate for 55 medium tanks. A tough, pressed wood was recently substituted for steel reflectors in fluorescent lights built for war plants.

An example of engineering ingenuity was the development of tiny helmet-like blackout caps to shield the red glow of signal lamps on outdoor electric transformers from possible enemy bombers.

Aluminum Co. of America's 1942 Developments

The United States, in 1942, produced aluminum at a rate greater than all Nazified Europe; it is producing, probably, eight times as much of the vital warplane metal as Japan. In the year we are now entering, we should reach in this country a peak which the entire Axis aluminum production cannot hope to achieve.

With Alcoa's $250,000,000 expansion nearing completion during 1942 and with other privately-owned and government-financed plants in operation, the United States produced during the year more than a billion pounds of aluminum. When the plants Alcoa is building for the Defense Plant Corp. are completed and the peak of 1943 production is reached, there will be a capacity in this country to make 2,100,000,000 lb. annually. This is 63 per cent more than the aluminum production of the whole world in 1938. Of this total, Alcoa is scheduled to produce a major portion in its own plants and those it will lease from the government.

Expansion of fabricating facilities is keeping pace. Alcoa forging output is now 25 times what it was before the war. Production of castings has been multiplied 11 times; extruded shapes and tubing, nine times. One sheet mill alone is turning out monthly one and one-half times as much high strength alloy sheet, the kind used in warplanes, as the entire nation used in a whole year before the war.

This sheet mill, located in Tennessee and built in record-breaking time, has capacity to roll sheet 50 times as fast as it could be rolled 2 yr. ago.

In all, Alcoa is building or has built, 21 major plant projects for the government and will operate them on lease. Some of these plants were put into operation in 1942 and all of them will be producing during the new year.

Department of the Interior

Bonneville and Grand Coulee Dams, gigantic federal power projects on the Columbia River, have become an integral part of the war might of the United States, Paul J. Raver, power administrator, said in his annual report to the Secretary of the Interior.

Both from the standpoint of actual power deliveries and from the standpoint of "demand value" of contracts executed, the Administration's power sales showed heavy gains during the fiscal year 1942. Of power actually delivered, war industries, comprising principally aluminum and shipbuilding, as well as chemicals and other munitions of war, purchased 81.4 per cent; private utility companies 14.7 per cent; public agencies 3.8 per cent; and federal agencies 0.1 per cent.

The impact of the war program in the area served by the Administration was reflected by the placing of war contracts totaling $1,259,449,000. These covered the manufacture of aircraft, ships, ordnance, military, and naval supplies and the construction of barracks, docks and munition depots, all in Oregon and Washington. This figure does not include the purchase of raw materials such as aluminum, copper, zinc, lead and timber products in the area.

The Administrator reported that at the end of the fiscal year, the Bonneville-Coulee Power Administration operated a transmission system containing 1748 mi. of transmission lines and 37 substations. During the year the Administration also acted to integrate all of the Northwest's power resources to provide greater security of service for the growing war load.

Expansion of hydroelectric power in the West, the utilization of hitherto little-used ore deposits and the development of new metallurgical processes for production of war materials highlighted Department of Interior activities during the year, Secretary Ickes said. Installed capacity on the Federally-owned power projects under the Department of the Interior jumped 41 per cent to a total of approximately 1,800,000 kw. In the Pacific Northwest alone, Secretary Ickes reported, the Bonneville Power Administration delivered almost 2,000,000,000 kw-hr. of hydroelectric energy to war plants.

Tennessee Valley Authority

The Tennessee Valley Authority reported to the President and Congress that all its facilities in the fiscal year of 1942 were devoted to aiding the Nation in the War. As of June, 1942, it had increased its electric generating capacity by almost one-third to 1,374,500 kw. It became one of the largest power producers in the United States, with generation of power exceeding 6 billion kilowatt-hours annually. (Production now is at the rate of nearly 10 billion annually.) More than 70 per cent of TVA power goes into war production, largely in great electro-metallurgical and electro-chemical plants in the Valley, including a large proportion of the Nation's aluminum production.

During the fiscal year, TVA commenced construction of eight dams for war production of power and continued work on three dams on shortened wartime schedules. Four dams and a large steam plant commenced operation, and 500 mi. of transmission line were built, increasing the network by 10 per cent. A major interconnection with power systems to the North was effected, making possible more efficient use of power facilities in the TVA and adjoining areas.

NO. 2 OF A SERIES

HOW TUBE-TURN WELDING FITTINGS BENEFIT WAR INDUSTRY

The ★ FIRST WELDING FITTINGS 1ST AND STILL THE BEST

Two ways that Tube-Turn welding fittings avoid wasting men and hours in war plants!

ster installed, trouble-free piping steps-up production schedules!

TUBE-TURN fittings speed up piping installation four ways: (1) Need only butt-welds, easy for veteran or novice welders. (2) Less lining-up, for gs have *uniform* walls and true circularity. Sections pre-assembled on the ground save . (4) Torch cutting and fabricating are inated. Tube-Turn fittings are ready to weld pes, sizes and weights for all needs.

You can depend on piping welded with Tube-Turn fittings to be practically maintenance-free, as Tube-Turn welding fittings give the *greatest possible strength* and *long life*. They're *permanently leakproof*. There are no bolts to loosen, no gaskets to replace, no threads to corrode and weaken.

No plant *ever* can afford a break-down or production slow-up, but in war-time it's a disaster! The best insurance in the world against trouble in piping systems is *welding* with *Tube-Turn fittings!*

TUBE TURNS, (INC.) LOUISVILLE, KY. ● *Branch Offices*: New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Tulsa, Houston, Los Angeles. ● *Distributors in principal cities.*

UBE-TURN *Welding Fittings*

TRADE MARK

★

OTHER WAR-TIME ADVANTAGES:

SAVES CRITICAL MATERIAL: Absence of many flanges, bolts, nuts and heavy cast steel construction saves many tons of metal in a single piping system.

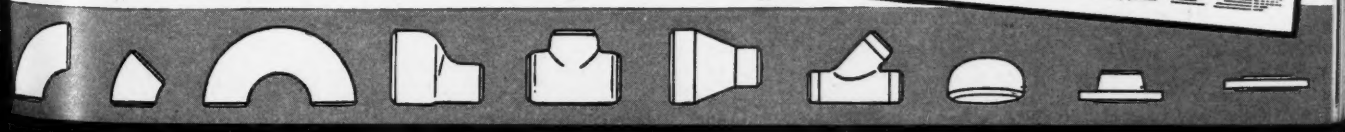
FASTER AND EASIER TO INSULATE: Tube-Turn fittings are insulated as easily as the pipe itself, for the welds form one continuous tube.

SAVE SPACE: Pipe systems welded with Tube-Turn fittings permit streamlined, compact layouts and sharp angles.

LAST LONGER: Smooth inner walls—with no ridges, waves or scale—means less corrosion and longer life.

LESS PRESSURE LOSS: Because of full effective radius and exact O.D. and I.D. alignment with the pipe, the flow is more efficient and pressure loss is less.

FEWER SUPPORTS NEEDED: Since welded piping weighs less and stands vibration better than flanged systems, few hangers or supports are required.



War News From the Industrial Front

Technical Students Urged To Register with Roster

FOLLOWING recent increases in demand for technically trained personnel, the National Roster of Scientific and Specialized Personnel recently urged senior and graduate students of chemistry, physics, engineering, and other specialized fields to register their skills.

To register with the Roster, a man or woman with scientific or other specialized training should write to Dr. Leonard Carmichael, Director, National Roster of Scientific and Specialized Personnel, War Manpower Commission, Washington, D. C., mentioning the field or fields in which he or she has training or knowledge.

Uses of Oil from Coal Studied

CONTINUING a long-range study of the hydrogenation of coal to produce gasoline, lubricating oil, and other related products, Bureau of Mines chemists are now engaged in analyzing the crude oils made from coal to determine their possible uses in various fields of industry, according to Dr. R. R. Sayers, director of the Bureau of Mines.

In advising Secretary of the Interior Harold L. Ickes of the publication of a new technical paper on the subject, Dr. Sayers pointed out that the Bureau has been producing gasoline and oil from coal on a semi-commercial scale at the Pittsburgh, Pa., pilot plant for some time.

The operation of internal-combustion engines with motor fuel produced at the Bureau's plant is an established fact, Dr. Sayers stated, and attention is now being directed toward the significance of the process as a source of compounds and solvents used in the lacquer and plastic industries, in making special fuels, aromatics, raw material for synthetic rubber, and in other fields.

Less Lumber Scheduled in 1943

LUMBER consumption for 1943 is estimated at approximately 31,100,000,000 board ft. compared with 40,200,000,000 ft. for all purposes in 1942. The estimate is contained in a bulletin of the lumber and lumber products division of WPB, addressed to members of the softwood loggers and lumber manufacturers advisory committee.

Bituminous Coal Production

THE ESTIMATED production of bituminous coal for the week ended December 12 approached the season's peak rate while no increase was experienced in the production of anthracite, Coordinator for Solid Fuels Ickes, said December 21.

The Bituminous Coal Division estimated soft coal production for the week at 11,500,000 tons as compared with a revised estimate of 11,115,000 tons for the week ended December 5. The Bureau of Mines estimated anthracite production at 1,101,000 tons for the week, precisely the same as for the previous week.

The Coordinator expressed belief that the bituminous coal increase was due partly to seasonal influence and partly to the fact that many consumers are heeding his advice to increase their storage whenever coal is available.

Jobs for Women Engineers

SO GREAT is the Government's demand for civilian junior engineers that women with college degrees in any field may now qualify for junior engineer positions in the Federal Civil Service by taking a short tuition-free course. In order to supplement the rapidly diminishing supply of male engineers, many of whom are entering the armed forces, the United States Civil Service Commission and the United States Office of Education have developed such a course to prepare women for engineering activities, and have made arrangements for any institution offering college engineering training to give the course, provided a sufficient number of persons enroll. Those who successfully complete the course and are otherwise qualified are eligible for junior engineer positions paying an entrance salary of $2000 a year in Washington, D. C., and throughout the United States.

Semi-trailers to Haul Oil

FIVE HUNDRED additional semi-trailer petroleum tanks will be produced to help relieve the oil transportation shortage throughout the country. Manufacture of 300 semi-trailer petroleum tanks by January 31, 1943, previously was permitted. Those now authorized are of the same type and will bring the total up to 800.

Each semi-trailer tank to be manufactured will haul 4000 gal. or over, more oil per pound of steel and rubber and man power than any other type of vehicle. It is estimated that one trailer replaces 11 railroad cars on hauls of less than 100 mi. Every effort is being made to have these 500 additional vehicles produced and hauling by February 15.

Glass Precision Gages Substituted for Steel

PLANS for large-scale substitution of glass for steel in the manufacture of precision gages used to inspect war materiel were announced by the conservation division.

Hundreds of thousands of steel gages are now in use by manufacturers and inspectors of ordnance items. Half of them can be replaced by glass gages, the Army Ordnance Department recently reported. The glass gage, no longer in the experimental stage, is now in use at Frankford Arsenal.

Saving of three-quarters of the man-hours of machine tool labor required for the manufacture of steel precision gages, as well as significant quantities of critical alloy tool steel, will be obtained by use of glass gages. The cost of glass gages is only half that of steel gages once the molds for the glass gages are made. Visibility in inspection, not always possible with steel, will tend to produce a superior product. Perspiration on the hands of inspectors has no corrosive effect on the glass gage as it has on steel. The thermal conductivity of glass is less than that of steel, and therefore heat transferred from the hands of inspectors to the gage will not affect gaging dimensions.

Petroleum Flow High to Seaboard States

PIPELINE deliveries of oil into the seaboard states are now running at an all-time high, Petroleum Administrator for War Ickes reported last week, but at the same time he cautioned that the supply received by pipeline is not sufficient to overcome the oil shortage in the East.

Machine Tools Preference Rating

ORDERS for machine tools must be accompanied by a photostatic copy or a certified copy of the preference rating certificate under which the buyer obtained his rating, the WPB ordered in a new amendment to General Preference Order E-1-B.

Copper Sets New Mark

COPPER production also established new marks, while chromite, molybdenum, vanadium, tungsten, cadmium, barite, fluorspar, potash, phosphate rock and high-grade clays also achieved record outputs. Domestic manganese ore production was the largest on record since the last war.

Minerals used in construction were on the upgrade generally, with cement sales increasing 10 per cent, sand and gravel up 7 per cent, and stone, about 9 per cent. The exceptions were lime and gypsum, which showed a decrease due chiefly to shrinkage in civilian construction. A slight decline in crude petroleum production was reported as the result of transportation difficulties which necessitated regional restraints on consumption.

Coal Assured New Englanders

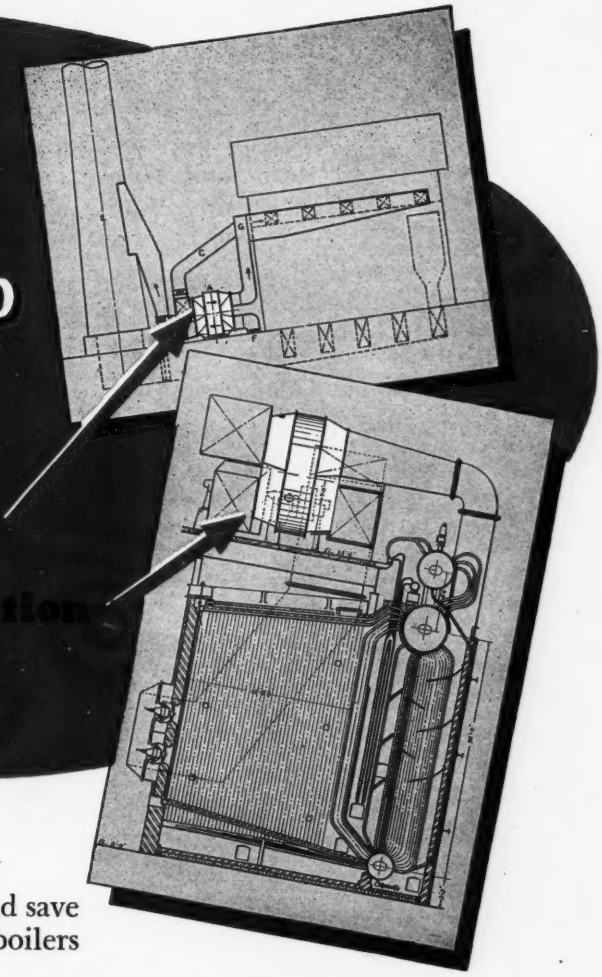
SCARCITY of anthracite is not a valid reason for New England fuel oil users to delay switching to coal, since adequate bituminous coal can be made available to them, announced Solid Fuels Coordinator Ickes.

Pointing out that in the last calendar year approximately 30,000,000 tons of all types of coal were shipped into New England—a gain of about 20 per cent over the previous year—the Coordinator said that current bituminous coal requirements are being met, and that shipments into that region can be increased if consumers and dealers will order the coal.

The tightness of the anthracite supply apparently is causing many fuel oil users to delay converting to coal, Mr. Ickes said, but these consumers are overlooking the fact that bituminous coal generally can be used instead of anthracite for domestic heating, and that an additional soft-coal supply can be made available to New England at the present time. Also, soft coal can be made available for commercial and industrial conversions.

DOUBLE-BARRELED Conservation For Oil Plants

In Refining
In Steam Generation



Ljungstrom Air Preheaters save steel and save fuel used on oil heaters as well as on boilers

On oil-plant steam generating units, Ljungstrom Air Preheaters are fast becoming standard. Recent orders for steam generating plants of *three different oil companies* . . . being supplied by *three different boiler manufacturers* . . . all call for Ljungstroms.

There's a double-barreled reason for this preference: (1) The increasing need for fuel conservation, even where it is freely available at low cost, raises the importance of improved combustion and heat recovery obtained with preheated air. (2) The Ljungstrom Air Preheater gives more heat recovery per pound of steel. Frequently a Ljungstrom weighs only ½ to ⅓ as much as alternate types, with additional savings in the supporting structure.

On cracking still furnaces, too, preheated air does double duty for conservation: (1) It lowers fuel consumption, (2) It permits a significant reduction in the alloy steel convection tube banks. Exit gas temperatures from the furnace as high as 1400 deg. F. are practical with "high-temperature" Ljungstroms, heating combustion air to 1000 deg. F. or more. This means maximum heat recovery per pound of oil-tube steel.

A new illustrated booklet, "Another Kind Of Air Power With A Wartime Job To Do", tells how the Ljungstrom is being used in wartime service. Case history information of savings resulting from use of the Ljungstrom makes it worthwhile reading. It's yours for the asking. Write for a copy today.

THE
AIR PREHEATER
CORPORATION

Executive Offices: 60 East 42nd Street, New York, N. Y. • Plant: Wellsville, New York

New Equipment

Information that you desire about any equipment will be gladly furnished without obligation. WRITE POWER PLANT ENGINEERING.

Oil Window

BIJUR LUBRICATING CORP., Long Island City, N. Y., has developed the Bijur Oil Window Unit, a new preassembly unit for conveniently indicating the oil level when the unit is installed in a built-in oil-reservoir casting.

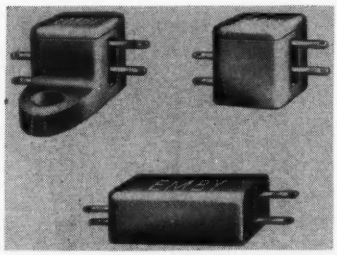
The unit consists of a window of clear plastic assembled in a polished metal housing, with a special oil-proof synthetic gasket to insure oil-tightness between window and frame. The bright background of the housing together with the plastic window provide sharp visibility of the oil level. Two holes in the metallic background allow easy passage of the oil.

By using the assembly tool, the unit may be pressed into a reamed hole in the machine casting, provided the casting wall thickness is ¼ in. or more. The assembly tool insures correct alinement of the oil window unit with the machine face and prevents scratching of the window. A thin coating of glyptol, shellac or other oil-proof sealing material applied to the surface of the reamed hole just before inserting the window unit will insure an oil-tight installation.

The Bijur Oil Window Unit is available in sizes to give a clear window diameter of ⅝, 1 and 1¼ in., respectively. Preassembly is made for economy in manufacturing cost and in the user's time required for installation.

Compact Rectifiers

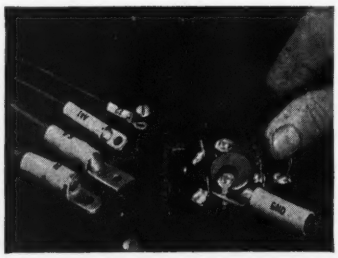
A NEW line of instrument and relay rectifiers is announced by Emby Products Co., Los Angeles, Cal., embodying light weight, compactness and adaptability in their design. These rectifiers are of the selenium type, utilizing the unipolar conductivity of the metal to selenium junction for rectification purposes. Eight sizes, with outputs ranging from 8 to 120 ma. are available. They are permanently stable and have unlimited life, according to the manufacturers they can be used under the most difficult operating conditions and



will withstand temperatures up to 70 deg. C. Small in external dimensions and light in weight additional mounting brackets are unnecessary; the only assembly operation required is soldering of the terminals. These rectifiers are supplied in two series; Series "L" in well insulated metal cases and Series "S" in unbreakable molded enclosures.

Insulator and Wire Marker

A NEW combination insulator and wire marker is announced by the Irvington Varnish & Insulator Co., Irvington, N. J. It consists of short lengths of extruded plastic tubing clearly marked with letters and numerals to perform two jobs, insulators of terminal connections and wire markers. Where lug insulation and wire identification are required, it speeds assembly by eliminating any additional means of identification.

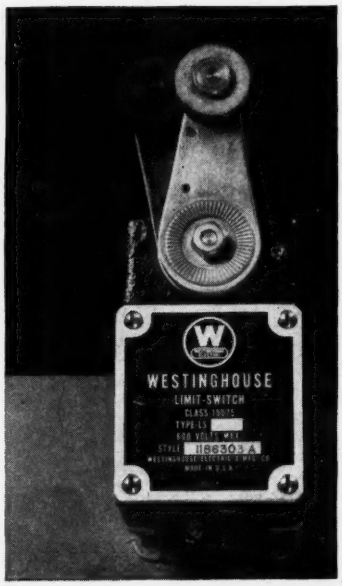


These insulator-markers are made from tubing with very high dielectric strength, smooth inside surface to permit quick application over wires and lugs. Legible numerals specified by the customer are printed on the tubing with an ink which is resistant to chemicals, water and oils equal to that of the tubing itself. They are available in colored tubing with either black or yellow symbols, in A.S.T.M. sizes from No. 9 to ⅜ in I.D., or larger sizes may be obtained if desired.

Limit Switch

THE TYPE LS limit switch, for heavy-duty applications, designed primarily for making and breaking control circuits or indicating circuits at a fixed point in the operating cycle, is announced by Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

This Type LS limit switch is of the roller arm, spring return type, using replaceable double-break self-alining silver-to-silver contacts for long life and dependable operation. It is provided with a set of normally open and



a set of normally closed contacts and is protected from accidental damage by a heavy cast-iron enclosure. All wearing surfaces are hardened steel or made of special alloys, and all corrodible parts are cadmium-plated.

This switch is easy to install and simple to inspect and service. The operating arm can be set in any one of 30 positions and is available in two sizes. The standard arm is 2⅛ in. and the short arm is 1½ in. between centers.

Plastic Patching Material

PLANT floor repair may be done with a new plastic patching material, announced by the Flexrock Co., 2333-B Manning St., Philadelphia, Pa. Already mixed, it need only be shoveled into place and tamped; traffic compacts and helps feather-edge to complete the job. Aisleways, ramps, platforms and busy shipping areas can be repaired and opened to traffic soon after application. It is said not to bog down under standing loads.

An announcement

concerning

replacement parts for DE LA VERGNE DIESEL ENGINES

America's war production has created unprecedented demands for De La Vergne Diesel Engines. Our shops are working 24 hours a day, producing De La Vergnes to aid our armed forces to bring Victory at the earliest possible moment. Naturally, *new* diesel engines must come first. But in spite of this, we are doing everything in our power to produce replacement parts despite the difficulty in securing critical and other materials.

You can aid the war effort, yourself, other owners and us here at Baldwin by ordering *only those replacement parts you need* to keep your De La Vergne in operation. We will do our best to get you what you need, as quickly as we are permitted to make and ship parts.

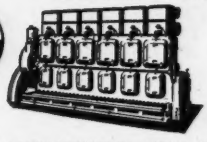
Your cooperation and patience will be sincerely appreciated, by us, our many customers and those units of the armed service which are using De La Vergne to speed Victory. Baldwin De La Vergne Sales Corp., a subsidiary of The Baldwin Locomotive Works, Philadelphia, Pa.

BALDWIN

De La Vergne

SALES CORP.

BLW THE BALDWIN GROUP



SUBSIDIARY OF THE BALDWIN LOCOMOTIVE WORKS • PHILADELPHIA

Storage Batteries

A NEW line of Vitrabloc storage batteries in which rubber has been replaced by a vitrified ceramic composed entirely of non-critical materials, is announced by the Storage Battery Division of Philco Corp., Philadelphia, Pa. These batteries can be furnished promptly on A-3 priority ratings.

This new line offers the same capacities and practically all the advantages of the rubber jar battery developed by Philco for telephone and stand-by use. This new ceramic product doesn't absorb moisture, nor will acid penetrate or affect it. Pure white in color, Vitrabloc jar gives engineers one feature they've wanted for years—high light reflection to brighten dark battery rooms. Because of its glassy surface and spray-proof funnel vents, the jar can be kept clean with very little attention. Vitrabloc is explosion-proof and can be set up next to other electrical equipment.

Coolant Pumps

INGERSOLL-RAND Co., 11 Broadway, New York, N. Y., announces a number of additions to its line of coolant and circulating pumps. These new pumps are particularly suitable for installation on machinery requiring a coolant or circulating unit, for example on lathes,

drills, automatics, cut-off machines and grinders which require a constant supply of cooling fluid or cutting oil. They are also applicable to evaporative condensers, air-conditioning units, washers, etc.

These pumps include ¾ and 1 in. side-wall-mounted types, a 1¼ in. side-wall-mounted type for low-submergence applications, and a 1¼ in. horizontal type, in capacities ranging from 5 to 150 g.p.m. for heads up to 125 ft.

MANUFACTURERS' PERSONALS

Tube Turns, Inc., Louisville, Ky., announces that an indefinite leave of absence has been granted to John H. Romann, chief metallurgist of the company, in order that he may devote all his time to the position of chairman of a committee formed by the War Metallurgy Committee of the National Research Council, National Academy of Sciences, to make a nation-wide investigation in industrial plants concerning the low temperature properties of metals. This research is being carried on for the War Department.

C. F. Poirier, Electrical Advisor to the Shipbuilding Division of the War Production Board, has submitted his resignation and resumed his former connection with Crocker-Wheeler Electric Mfg. Co.

The recent merger of Crocker-Wheeler Electric Mfg. Co. with Joshua Hendy Iron Works makes his return to the Crocker-Wheeler organization advantageous to the proper conduct of that company's war effort. Mr. Poirier is general sales manager.

O. W. Trumbull, formerly of Asbestos Textile Co., is now connected with Greene, Tweed & Co. of New York and was recently appointed vice-president and general manager.

J. M. Zimmerman, lawyer and electrical engineer, has been named staff manager for the Pacific Coast District, Manufacturing & Repair Department, Westinghouse Elec. & Mfg. Co. In his new post, Mr. Zimmerman will supervise repair activities, pricing and contracts throughout the district, which includes the headquarters plant in Emeryville, Cal., and plants at Los Angeles, Seattle, Portland and Salt Lake City.

An electrical engineer who has served with Westinghouse for more than 20 yr., Mr. Zimmerman also is a law school graduate and a member of the Illinois State Bar. He studied law at night at Loyola University while working days as maintenance supervisor for the company's Northwestern District, headquartered at Chicago.

J. W. Belanger was recently appointed manager of General Electric's Federal & Marine Department, as announced by E. O. Shreve, vice-president of the company. In his new capacity, Mr. Belanger succeeds D. W. Niven, manager since 1921, who will continue as a member of the department available for consultation and special duties.

Philip D. Reed, chairman of the board of the General Electric Co., recently resigned all of his Company posts, to continue his work in London as Deputy Chief of the Harriman Mission. Mr. Reed will return to England shortly to resume his duties, which he took up in July, 1942.

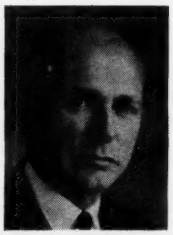
The Board of Directors of Beaver Pipe Tools, Inc., Warren, Ohio, announces the following changes in operating officials: W. A. Neracher, founder of the Company 43 yr. ago and president during this entire period, was elected to a newly-created position as Chairman of the Board. W. A. Phillis, formerly vice-president, becomes president and general manager; M. W. Bechtel, executive vice-president and treasurer; C. W. Shafer, vice-president, manufacturing; E. R. Brakley, vice-president, sales; and R. C. Mellinger, vice-president, accounting.

A. J. M. Baker, with a background of many years in the industrial field, has accepted the position of General Manager of Crocker-Wheeler, now a Division of Joshua Hendy Iron Works, Sunnyvale, Cal. Coming to this country from England in 1906, Baker joined the Cincinnati Milling Machine Co. and later held various responsible positions with the War Industry Board during the first World War, with Willys-Overland, with Hercules Motor Co., and with the British Purchasing Commission which he recently resigned in order to go with the Joshua Hendy Iron Works.

David Hall, 68, Westinghouse engineer since 1908 and active in the electrical industry for the past 46 years, retired January 1, 1943.

Mr. Hall has headed engineering activities for Westinghouse in the Los Angeles area since 1926. He served as engineering supervisor until mid-1941, when he was named assistant to the Pacific Coast District engineering and service manager and assigned to special work. He was succeeded as engineering supervisor by his son-in-law, E. W. Morris, also of Los Angeles.

Commonwealth Edison Personnel Changes



Alex D. Bailey

ALEX D. BAILEY, chief operating engineer of Commonwealth Edison Co., Chicago, Ill., was advanced recently to the position of assistant to the vice-president in charge of operating and engineering. He will assist vice-president H. B. Gear in the administration of the departments under his direction and will have general supervision over Powerton Generating Station and its related transmission system.

Paul B. Juhnke, assistant chief operating engineer, was promoted to Mr. Bailey's former post and Mr. Juhnke was succeeded by Arthur E. Grunert, who will also continue for the present as superintendent of generating stations. Uriah Davis, assistant chief load dispatcher, was appointed chief load dispatcher.

A veteran of 39 yr. of service with Commonwealth Edison Co., Mr. Bailey is widely known throughout the electrical industry. He started his utility career in 1903 as a draftsman at Harrison Street Generating Station and rose through the ranks to chief engineer at Fisk and Quarry stations, su-

Guard YOUR turbines with this oil that helps to

KEEP OUR SUBS ON THE PROWL!

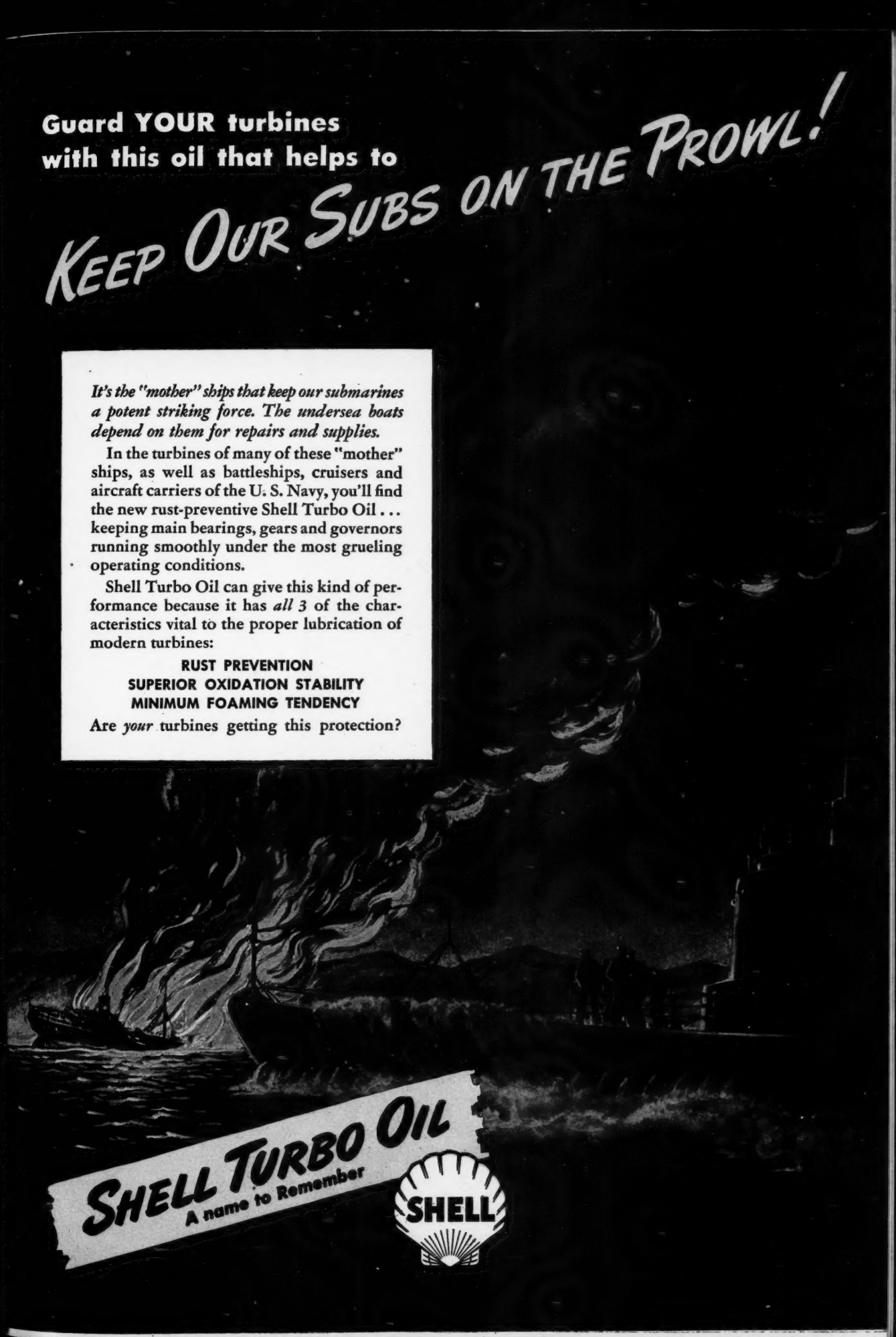
It's the "mother" ships that keep our submarines a potent striking force. The undersea boats depend on them for repairs and supplies.

In the turbines of many of these "mother" ships, as well as battleships, cruisers and aircraft carriers of the U. S. Navy, you'll find the new rust-preventive Shell Turbo Oil . . . keeping main bearings, gears and governors running smoothly under the most grueling operating conditions.

Shell Turbo Oil can give this kind of performance because it has *all 3* of the characteristics vital to the proper lubrication of modern turbines:

RUST PREVENTION
SUPERIOR OXIDATION STABILITY
MINIMUM FOAMING TENDENCY

Are *your* turbines getting this protection?



SHELL TURBO OIL
A name to Remember

SHELL

The Explanation OF A DART'S LONG LIFE

lies in the way it is made

... and here are some important Dart Features

While it has long been well known throughout industry that Dart Unions can be used over and over again, giving tight-joint performance each time, never has the extra-value of Dart Unions been more fully realized than it is right now.

Here are some reasons *why* Dart Unions give the outstanding performance for which they are famous. First, Darts have extra-wide matched bronze seats that are ground to "true-ball" surfaces. Another important reason is that Dart bodies and nuts are made of High-Test air-refined malleable iron that resists pipe strains, and rough handling.

In the interests of metal conservation, please continue to search your plant for used Dart Unions . . . for, as you know, they can be put back to work. And see your supplier now as you need new ones.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.

perintendent of generating stations and assistant chief operating engineer. He was elevated to chief operating engineer in 1936.

Mr. Bailey was vice-president of the American Society of Mechanical Engineers in 1936-37 and was a member of the LaGrange, Ill., village board for 14 yr., serving as president from 1935 to 1937. He is now vice-chairman of the board of trustees at the Illinois Institute of Technology.

Mr. Juhnke, whose company service also dates back to 1903, worked as an electrician's helper, oil switch repairman and construction foreman before transferring to the load dispatcher's office in 1905. He became chief load dispatcher in 1912 and last Fall was promoted to assistant chief operating engineer.

Entering the company's employ in 1908 as a draftsman, Mr. Grunert was successively promoted to testing engineer, assistant efficiency engineer and efficiency engineer. He was appointed superintendent of generating stations in 1934. Mr. Davis started as a substation operator in 1904, transferred to the load dispatcher's office two years later and became assistant chief load dispatcher in 1924.

Westinghouse Personnel Changes

BERNARD H. SULLIVAN, manager of sales for the Westinghouse Lamp Division, Bloomfield, N. J., has been assigned responsibility for all commercial activities involving lamps and special products, and Ralph C. Stuart has been appointed manager of manufacturing and engineering for the Division as announced by George H. Bucher, president of the Westinghouse Elec. & Mfg. Co.

Mr. Sullivan will continue to have charge of the Illuminating Engineering and Commercial Engineering Departments, as well as sales, advertising and Division district offices. In addition, he will supervise activities of the Special Products Commercial Department. Under the new plan, Mr. Stuart, who has been manager of manufacturing, also will head engineering activities.

Charles F. Billings, for 19 yr. assistant superintendent of the Westinghouse Lamp Division plant at Trenton, N. J., has been appointed industrial relations manager of the Division. He succeeds Walter F. Oliver who has been granted a leave of absence to become Director of the Civilian Personnel Branch, U. S. Army Ordnance Department in New York City.

The officials will continue to make their headquarters in Bloomfield, N. J.

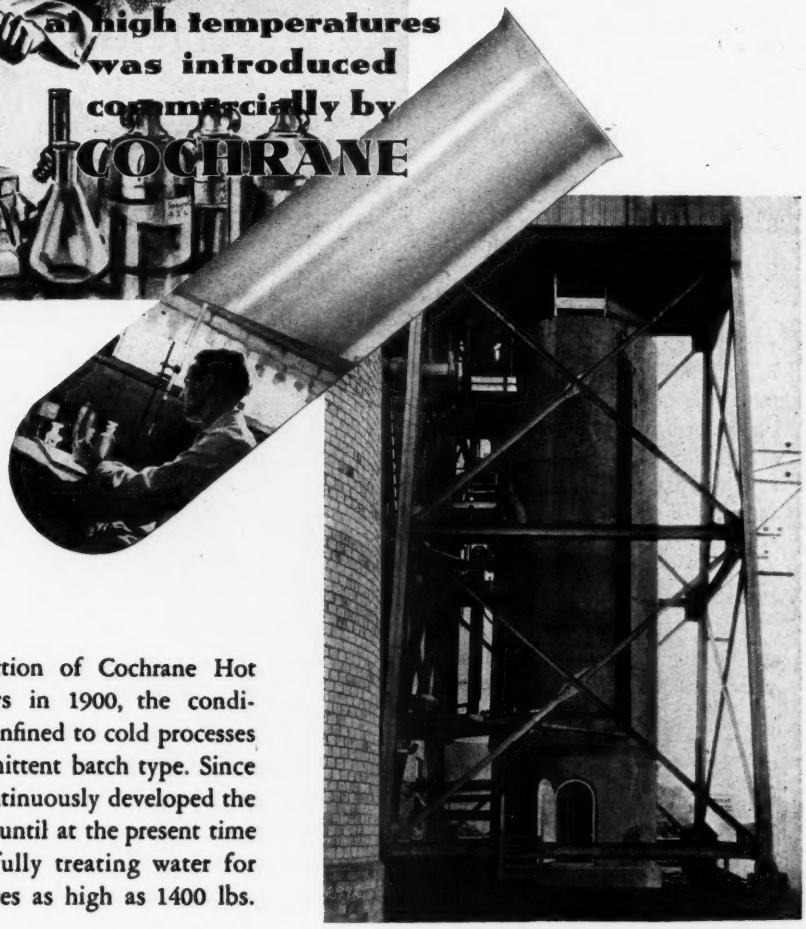
R-S Products Corp. Elects Vice-President

DAVID W. HOPKINS, secretary and director of the R-S Products Corp., Wayne Junction, Philadelphia, Pa., for a number of years, has been elected vice-president. This announcement followed a recent meeting of the board of directors. He will continue in charge of the company's Valve Division.

Mr. Hopkins was graduated from the University of Pennsylvania as a mechanical engineer and later took

Softening Boiler Feedwater

at high temperatures was introduced commercially by COCHRANE



From Laboratory Analysis to the Production of the Equipment . . .

COCHRANE all the way

PRIOR to the introduction of Cochrane Hot Process Water Softeners in 1900, the conditioning of feedwater was confined to cold processes of the continuous or intermittent batch type. Since that time, Cochrane has continuously developed the process and the equipment until at the present time this apparatus is successfully treating water for boilers operating at pressures as high as 1400 lbs. per square inch.

All of the developments listed at right were pioneered by Cochrane, culminating in the present-day apparatus, the most versatile method of water treatment for boiler feed purposes. It is pioneering that has maintained this leadership since Cochrane introduced the original Hot Process Water Softener in 1900.

COCHRANE CORPORATION
3123 N. 17th Street, Philadelphia, Pa.

COCHRANE

SOFTENERS · DEAERATING SOFTENERS · DEAERATORS · METERS · STEAM SPECIALTIES

Some of the outstanding Cochrane developments in water conditioning are as follows:

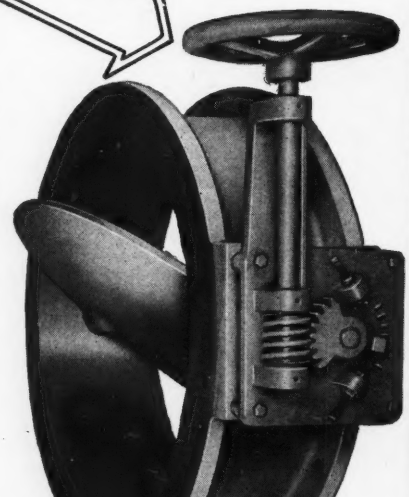
1. The use of non-silicious filtering material.
2. Back-washing filters with water from the sedimentation tank.
3. Application of jet heaters in place of tray heaters.
4. Supplementary treatment of phosphate as an adjunct to external treatment.
5. Treatment by phosphate in single- or two-stage apparatus.
6. Deaeration by atomization, eliminating entirely the use of trays.
7. Use of magnesium sulphate and other magnesium salts for reduction of silica.
8. Use of phosphoric acid as a treating agent in single- or two-stage water softeners, producing controlled alkalinity and zero hardness.

6 Hand Wheel Revolutions

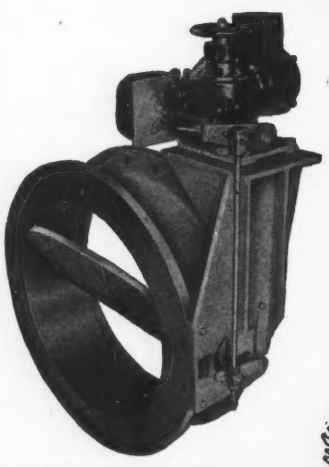
Complete Full Vane Movement

Designed for the control and wedge-tight shut-off of any material that flows or is forced through a pipe

Six revolutions of the hand wheel fully open or close this R-S Butterfly Valve. Compare this quick action with that of ordinary valves. Consider, too, that R-S Valves are comparatively light in weight. They effect a considerable saving in installation costs since less space and supporting structure are required.



15 to 900 p. s. i.



Electric Motor Operated

Here is a simplified, precise and entirely Automatic Butterfly Valve for the shut-off and control of liquids and gases in power plants, water works, chemical industries and refineries. Hand wheel for manual operation in case of current failure. Available in iron or steel; sizes to 84 inches.

•

Detailed information and catalog furnished upon request.

BUTTERFLY VALVE DIVISION
R-S PRODUCTS CORPORATION
4535 Germantown Ave. • Philadelphia, Penna.

R-S Streamlined BUTTERFLY VALVES

post graduate work in aeronautical engineering at the Massachusetts Institute of Technology. He was a Navy flyer in the last war.

G. E. Advances R. W. Beard

R. W. Beard, who formerly handled planning and execution of the General Electric Federal and Marine program in the San Francisco territory, has been named assistant to the manager of the Company's Lighting Division in Schenectady, N. Y. A native of Toronto, Canada, Mr. Beard became a United States citizen shortly before World War I, later participating in that war. Upon graduation from the University of California in 1923 with a B. S. degree in electrical engineering, he joined General Electric as a testman, also completing the Company's advanced engineering course.

From 1925 to 1928, Mr. Beard served as arc welding and industrial heating specialist in the San Francisco Bay area. In 1928, he became associated with industrial equipment sales. Later in this connection he was instrumental in the promotion of sodium vapor lighting for the San Francisco Bay bridge and the Golden Gate bridge. He also was associated with A. F. Dickerson, manager of the Company's Lighting Division, in the planning of decorative lighting for the Golden Gate International Exposition.

Austin Co. Promotes Paton and Engstrom

W. G. Paton, of Cleveland, O., and W. R. Engstrom, of Seattle, Wash., have recently been made vice-presidents of The Austin Co., Cleveland, O.

Mr. Paton, a native of Glasgow, Scotland, and educated in Civil Engineering at the Royal Technical College of Scotland, joined the Austin organization in 1919, as a structural engineer.

In 1938 he became assistant to the general manager, and has served in that capacity since. In addition to his election as a vice-president, Mr. Paton also will assume the posts of assistant secretary and assistant treasurer of the company.

Mr. Engstrom was born in Perrebonne, Minn., and is a graduate in Civil Engineering of the University of Washington. A private in the United States Army in World War I, Mr. Engstrom joined the Austin organization as a field engineer in 1925 in the Seattle territory. He became assistant to the Austin district manager in Seattle, in 1929, and district manager in 1933.

In 1940 Mr. Engstrom was given the additional responsibilities of general project manager of a U. S. Naval Air Station and Naval Supply Depot, and related Navy construction work in the Pacific Northwest where the Austin Co., since the outbreak of the war in Europe, has undertaken the design and construction of more than $100.000,000 worth of war facilities of all types.

This Valve never had a chance!

SENTENCED TO DEATH by "Sand Blast" effect, when incorrectly chosen and installed

THIS Iron Body Globe Valve served only a few months. It was riddled by a fusillade of dirt, grit, and scale carried in the water. Throttling accelerated the flow velocity and intensified the "sand blast" effect. The seat, disc, and body were damaged beyond repair. This needless destruction could have been prevented by choosing the correct type of valve for this service.

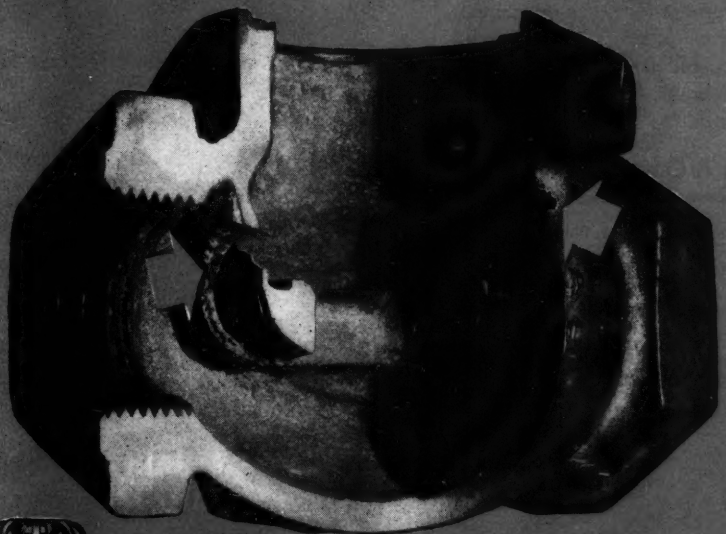
Since valve-failure often means serious interruptions in war production, and valve destruction wastes scarce metals, it is management's vital responsibility to keep valves operating efficiently.

Most valve trouble can be prevented before it starts . . . by frequent, thorough inspection . . . by repair or replacement of worn parts in time to prevent valves from destroying themselves. New maintenance workers should be taught to detect the first signs of trouble . . . to correct it without delay. Valves for new construction should be carefully selected, and properly installed.

Jenkins Engineers will provide any assistance you need in developing effective valve conservation programs for your company or clients.

Jenkins Bros., 80 White Street, New York, N. Y.; Bridgeport, Conn.; Atlanta, Ga.; Boston, Mass.; Philadelphia, Pa.; Chicago, Ill. Jenkins Bros., Limited, Montreal; London, England.

Note mutilation of steel bevel disc and integral seat by wire drawing effect of the abrasive jet . . . also, perforation of body where flow impinged.



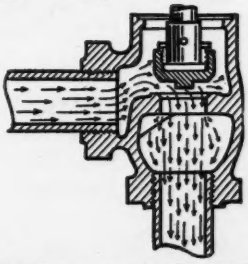
JENKINS VALVES

For every industrial, engineering, marine and power plant service . . . in Bronze, Iron, Cast Steel and Corrosion-Resisting Alloys . . . 125 to 600 lbs. pressure.

WRONG INSTALLATIONS may cause valve failure and production slow-downs

A globe valve was installed in a condensate line from a vulcanizer, carrying about 90 pounds steam pressure. See how the flow created excessive turbulence and subjected valve parts to destructive attack.

RIGHT INSTALLATIONS keep "fluid highways" serving the war effort



This is better practise for condensate discharge service: An angle valve, used in reverse position, offers less restriction to flow, decreasing turbulence. It discharges almost directly into the line; the seat acting as a funnel affords straight-down flow. Wear is reduced and service life is extended. A further improvement is the addition of a sediment trap to collect abrasive solids, and a blow-off valve to remove accumulated solids.

The angle valve is recommended for severe conditions in many services, such as continuous blow-downs, steam reducers, and soot blowers.

Army-Navy "E" Pennant, awarded to Jenkins Bros. for high achievement in the production of war equipment.

TRADE MARK JENKINS REG. U.S. PAT. OFF. Jenkins Bros.

Supervised Boiler and Condenser Cooling

System Protection at Moderate Cost!

We believe the true answer to your boiler water and condenser cooling system problem lies in competent supervision of water conditions by experts plus a simplified natural method of water correction. Our new Technical System does just that! Scheduled supervision and treatment based on frequent water analysis finds and remedies your trouble . . . specific organic formulas developed individually to fit your needs provide a simplified, natural correction. Send the coupon below for the new Technical System bulletin or have a Water Treatment Company engineer inspect your plant without obligation.

WHY NOT SEND THIS COUPON *NOW?* . . . *to*

American Radiator & Standard Sanitary
New York CORPORATION Pittsburgh

Cleveland, Ohio · Columbus, Ohio · Erie, Pa.
Fort Wayne, Ind. · Toledo, Ohio

BAILEY-FARRELL COMPANY
Charleston, W. Va. · Huntington, W. Va.

MUTUAL SUPPLY CO., Cincinnati, Ohio

or send to

☐ Please send the new Technical System bulletin.
☐ Have a Water Treatment Company engineer call.

Name ..... Title .....

Company .....

Address .....

WATER TREATMENT COMPANY of America
3559 HODGKISS STREET · PITTSBURGH, PA.

MANUFACTURERS' NEWS

ARMY AND NAVY "E" AWARDS

Crane Co.
Chicago, Ill.

General Asbestos & Rubber Division, Raybestos-Manhattan, Inc.
North Charleston, S. C.

The Fulton Sylphon Co.*
Knoxville, Tennessee

Dow Chemical Co.
Midland, Mich.

Babcock & Wilcox Co., Refractories Division
Augusta, Ga.

*Added star for sustained high achievement in production of war equipment.

The Dunkirk, N. Y., plant of the American Locomotive Co. was awarded the Maritime "M" pennant on December 18.

Thermix Engineering Co. has moved its offices from the Smith Building to the First National Bank Building in Greenwich, Conn. This firm is the Sales and Engineering Representative for Thermix dust collectors, stacks and recirculators and Heacon dampers.

The Charles F. Elmes Engineering Works recently became a part of American Steel Foundries, Chicago. The present Elmes organization will remain intact and will operate as a separate unit.

Current plans contemplate further improvements in manufacturing facilities for the production of some of the finest modern hydraulic presses, pumps, accumulators and special machinery. Such improvements will mean increased service to customers.

Charles F. Elmes will remain as general manager of Charles F. Elmes Engineering Works of American Steel Foundries. Business will be conducted at the present address, Morgan and Fulton Sts., Chicago, Ill.

The Green Fuel Economizer Co., Inc., Beacon, N. Y., celebrated its 50th anniversary on December 17. The company started manufacturing economizers in this country in October, 1892, prior to which time the economizers were made in Wakefield, England. The company is now operating at full plant capacity and is making equipment for large power plants.

Fig. 0601

YOU CAN BANK ON FAIRBANKS

for Bronze Check Valves

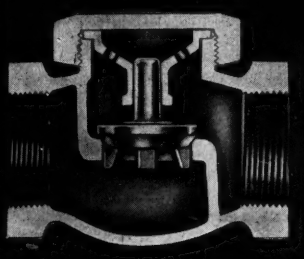


Fig. 0608

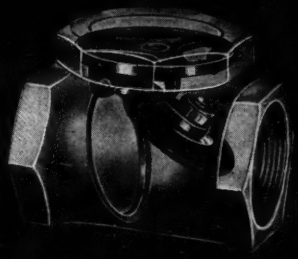


Fig. 0600

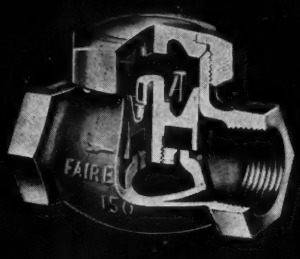


Fig. 0616

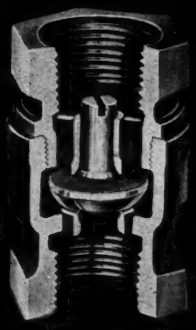
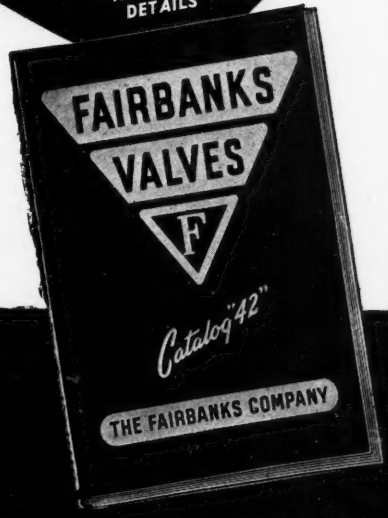


Fig. 0612

OTHER FAIRBANKS VALVES

Bronze Globe, Gate, Angle Cross and Check Valves
Iron Globe, Gate, Angle, Cross and Check Valves
Faircoseal Bronze Valves
U-Bolt Gate Valves
Asbestos Packed Cocks
Bronze Radiator Valves
Sphero Ball Valves

CONSULT FAIRBANKS NEW CATALOG No. 42 FOR DETAILS



Every Valve Tested for Closing Tightness before Shipment

SERVICE: Recommended for service on steam, water, gas or oil to prevent return flow. Available for steam workimg pressures from 125 to 350 lbs. at 700° F.

TYPES: Fairbanks Bronze Check Valves are made in horizontal, angle and vertical swing and lift types, with Renewable Bronze and Composition Discs.

FEATURES: These valves are of heavy construction, liberally proportioned and have large hexes with deep-cut pipe threads. The seat and disc can either be renewed when worn or easily reground, which greatly increases their life.

THE NEW AND COMPLETE FAIRBANKS CATALOG GIVES FULL DETAILS - SENT FREE ON REQUEST . . .

THE FAIRBANKS COMPANY

393 LAFAYETTE ST., NEW YORK, N. Y.
BOSTON, MASS. PITTSBURGH, PA.

Distributors in Principal Cities

R/M NORTH CHARLESTON PLANT

AWARDED ARMY-NAVY "E"

It is a tribute to American workers that more and more Army-Navy "E" burgees are being awarded. It shows the continuing upswing of America's production-curve as we enter our second year of the war. It promises an ever-increasing output that will crush our enemies by its very weight.

The North Charleston plant of Raybestos-Manhattan, Inc., is now privileged to fly this flag, "awarded for excellence in production." It is an award not lightly given, not easily held. It is an achievement and a challenge at one and the same time.

Raybestos-Manhattan accepts this Army-Navy "E" pennant in the name of its workers . . . the men and women who tirelessly turn out great quantities of R/M packings. It is to them, rather than to management, that we take off our hat and make a low, graceful bow. Nice going, North Charleston.

INDUSTRIAL SALES DIVISION
RAYBESTOS-MANHATTAN, INC.
MANHEIM, PA.
BRIDGEPORT, CONN. NORTH CHARLESTON, S. C. PASSAIC, N. J.
Makers of Packings for Every Industrial Use

American Coal Burner Co., Chicago, Ill., announces the appointment of Lester B. Hamersley as Sales Manager. Mr. Hamersley is a graduate of Armour Institute and has been with the company since 1938.

The Pearson Organization, founded 50 yr. ago by the late Dr. Fred Stark Pearson, has resumed activities as general and industrial engineers under the original corporate title Pearson Engineering Corp., with offices at 41 E. 42nd St., New York City.

Condenser Service & Engineering Co., Hoboken, N. J., announced recently that its main office will be located in the Seaboard Trust Bldg., 95 River St., Hoboken. Their former premises at 310 12th St. will be continued as headquarters for condenser and heat exchange maintenance and service crews and for storage of tools and equipment used in maintenance operation.

The Detroit Rex Products Co., metal cleaning engineers, announce the opening of their new Los Angeles office at 1506 Santa Fe Ave. S. B. Crooks, formerly of the company's Chicago office, is manager of the Pacific Region with headquarters in the Los Angeles office. W. A. Vensel, formerly Pacific Region Manager, will supervise sales and service in the Southern States.

Orders received by the General Electric Company during the year 1942 reached the all-time record total of $2,003,039,000, compared with $1,132,837,000 for 1941, an increase of 77 per cent, President Gerard Swope announced recently.

Hendy Co. Acquires Pomona Pump

CHARLES E. MOORE, president of Joshua Hendy Iron Works, Sunnyvale, Cal., recently announced the purchase of the Pomona Pump Co., Pomona, Cal., and its recently acquired subsidiary, the Westco Pump Division, St. Louis, Mo. Hendy also purchased the plant and equipment of the Hydril Co., Torrance, Cal., to supplement the facilities available at Pomona.

The purchase of this prominent pump manufacturer serving the irrigation, mining, water treatment, central station and domestic water supply fields, gives the Joshua Hendy Co. an additional complete line in the machinery field. This further rounds out the scope created by the recent purchase of the Crocker-Wheeler Electric Manufacturing Company, prominent half century old builders of electric machinery at Ampere, N. J.

The Hendy interests now embrace four of the major engineering fields: mechanical, electrical, hydraulic and steam, with steam engines, turbines, electric motors and generators, flexible couplings and a wide range of pump types, as well as ship propulsion equipment and large gear reduction units.

(*Continued on page* 129)

WHY SOME TURBINE OILS NEED CHANGING AND TREATING AND NONPAREIL DOES NOT

● Just how long a conventional turbine oil will last is anybody's guess. But each of them, sooner or later, should be changed or removed from the oil system for treating to reduce acidity, or for removing sludge deposits or water.

But not so with Nonpareil. Records of Nonpareil still in service after 10 to 15 years show that the oil has never been removed for treating, or for cleaning the oil system. Furthermore, Nonpareil is guaranteed not to increase in acidity above the extremely low neutralization number of 0.15.

WHAT HAPPENS TO A TURBINE OIL IN SERVICE?

The conditions under which turbine oils operate—rapid circulation, at fairly high temperatures—tend to increase chemical absorption of oxygen by the unstable hydrocarbons in the oil—that's called oil oxidation. This, in turn, brings on a host of oil troubles, such as high acidity, sludging, excessive increases in viscosity, and poor demulsibility. Any one of these is reason enough for removing the oil before it damages the turbine.

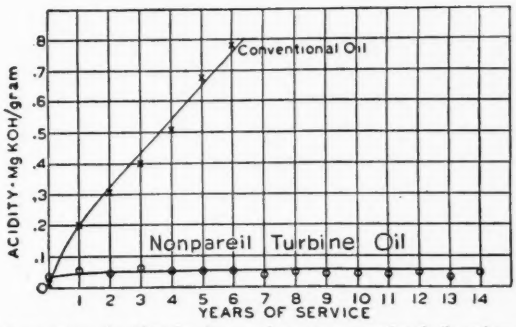
THE REFINER WAS IN THE MIDDLE

An easy solution might seem to be the removal of unstable hydrocarbons by refining. This can be and is done. But very highly refined oils frequently develop acidity faster than some less highly refined oils, because of the removal of natural inhibitors in the oil.

Therefore, until about 15 years ago, a turbine oil was of necessity a compromise product . . . not too highly refined to cause excessive acidity formation, but sufficiently refined to prevent excessive oxidation and sludge formation.

PATENTED INHIBITOR DEVELOPED

Then the *patented* inhibitor used in Nonpareil was developed. The inhibitor, added to a highly refined oil, prevents acidity development. Now, unstable hydrocarbons can be removed, which eliminates the sludge-forming and emulsion-producing tendency of the oil, and the inhibitor is added. Result—a turbine oil that lasts as long as your turbine, without replacement or treating. A small amount of make-up oil (about 10% per year) automatically replenishes the inhibitor. Your turbine oil systems never need cleaning and your fill of Nonpareil is *guaranteed* for the life of your turbine.



Comparison of acidity development between conventional oils and an inhibited turbine oil (Nonpareil) on all types of service. It shows the superior resistance to acid formation in Nonpareil even after 14 years of service.

GET ALL THE FACTS ABOUT THIS UNUSUAL OIL

If your plant is located in one of the states shown below, phone the nearest Standard Oil Company (Indiana) office for a turbine oil specialist. If not, drop us a card. Ask for our Engineering Bulletin number TN571 on Turbine Lubrication with Nonpareil Turbine Oil. In Nebraska, write Standard Oil Company of Nebraska, at Omaha.

COLORADO • ILLINOIS • INDIANA • IOWA • KANSAS • MICHIGAN
MINNESOTA • MISSOURI • MONTANA • NORTH DAKOTA • WYOMING
SOUTH DAKOTA • WISCONSIN

NONPAREIL TURBINE OIL

1. Stability Against Oxidation and Sludge.
2. Non-Corrosive. 3. Good Demulsibility.
4. Proper Viscosity Grades.

OIL IS AMMUNITION . . . USE IT WISELY

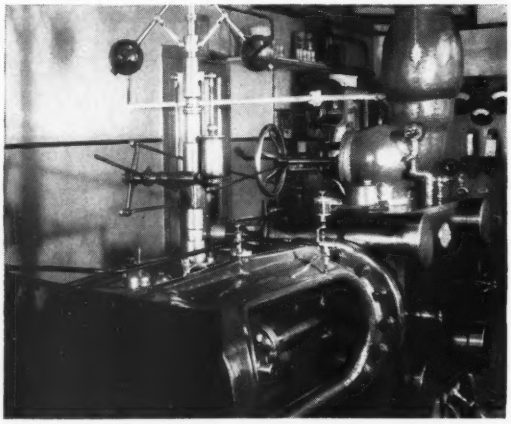
STANDARD OIL COMPANY (INDIANA)

NG • • LUBRICATION ENGINEERING • • LUBRICATION ENGINEERING • • LUBRICATION ENGINEERING • • LUBRICATI

G...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATIO

ONLY 2 SETS OF RINGS IN 40 YEARS WITH STANDARD STEAM CYLINDER OILS

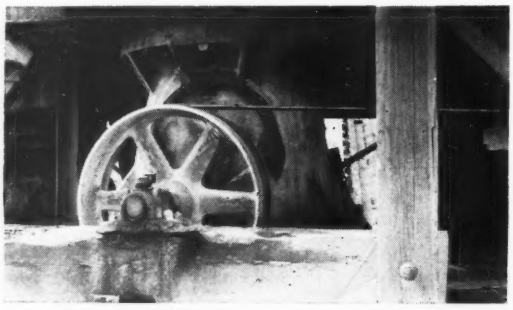
That's the kind of maintenance-reducing results that will help you meet today's emergency power demands. Here's the whole story. The engine, below, was installed in 1892. Even at that early date a Standard Oil Engineer was asked to recommend a cylinder oil. The engine was started on Capitol Cylinder Oil. To date, only two sets of rings have been replaced and the cylinder has never been rebored. There has never been a shutdown because of lubrication failure in the forty years. In that forty years, too, Standard Oil Engineers have gained

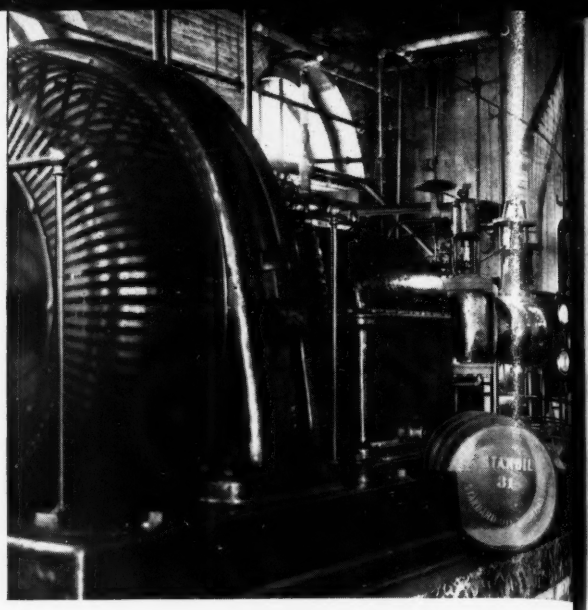


much experience and many new lubricants have been developed. Both are good reasons for turning to these Engineers for help in your present plant maintenance problems.

ALL-WEATHER LUBRICATION WITH SUPERLA GREASE

Because all bearings can't be operated in air-conditioned surroundings, some, like the crusher bearings pictured below, need the all-weather protection of Superla Grease. These bearings had been replaced twice because of overheating in Summer. A Standard Oil Engineer recommended Superla Grease. With it, no bearings have failed Summer or Winter—a saving in scarce material, labor, and productive time.





DOWN-TIME AND UP-KEEP CUT ON GEARED TURBINE WITH STANOIL

Here's what one metal mining and refining company saved when Stanoil cut oil replacements from once a year to once in four years on the geared turbine generator above. One oil system, of 200 gallons capacity, lubricates the 15,000 KW generator, reduction gear, and turbine. Once a year oil had to be changed and the system cleaned to remove deposits. Then Stanoil was tried. When it was replaced after four years, no cleaning had been needed in that time. That meant a saving in shut-down time and labor—that's important, right now. One fill of oil had been used in place of four, a saving of 600 gallons of oil, and a substantial reduction in oil costs had been made, although Stanoil was a higher quality product.

Try a fill of Stanoil in a speed reducer, circulating, or hydraulic system in your plant. Let a Standard Oil Engineer help you pick the application and the right grade of Stanoil. See how it will eliminate some of your labor and maintenance time.

HERE'S WHERE YOU'LL FIND A STANDARD OIL ENGINEER

Just phone any local Standard Oil Company (Indiana) office in the middle western states listed below, or write 910 South Michigan Ave., Chicago, Illinois. In Nebraska call or write Standard Oil Company of Nebraska at Omaha

COLORADO • ILLINOIS • INDIANA • IOWA • KANSAS • MICHIGAN
MINNESOTA • MISSOURI • MONTANA • NORTH DAKOTA
SOUTH DAKOTA • WISCONSIN • WYOMING

OIL IS AMMUNITION...USE IT WISELY

STANDARD OIL COMPANY (INDIANA)

OBITUARIES

J. W. Murphy

J. W. MURPHY, owner and head of The J. W. Murphy Co., Chicago, Ill., died Jan. 22, 1943, at Ft. Lauderdale, Fla. He had been ill since Oct., 1942 and had been sent to Florida for rest and treatment. He was 49 yr. old.

Mr. Murphy was born in Williams, Ind. Up to 1920 he was in charge of the sales and advertising department of Esterline-Angus Co., Indianapolis, Ind. In that year, believing that there was need for a specialized engineering service in the instrument field in Chicago, he established his company as an instrument sales and service business, originally representing the Esterline-Angus Co. and the Duncan Electric Co. Within a few months this list was extended to include The Hays Corp. and Carrick Engineering Co., which later became the combustion control department of The Hays Corp.

About 5 yr. later, The J. W. Murphy Co. became the representative of Cochrane Corp., handiing their flow meter line. In addition to these, the company now represents Northern Equipment Co., Buffalo Meter Co., R. W. Sparling and Associated Research, Inc.

Mr. Murphy was a member of the Western Society of Engineers, Association of Iron & Steel Engineers, Electric Association, Rotary Club of Chicago and Universal Craftsmen Council of Engineers.

C. A. Nickle

CLIFFORD A. NICKLE, consulting engineer at the General Electric Co. and one of the few men in the world to produce artificial diamonds, died December 8 at Schenectady, N. Y.

Mr. Nickle was born in Sharpsville, Pa., and graduated from the Pennsylvania State College in 1918 with a degree in electrical engineering. During World War I he served as an instructor in the U. S. Army Signal Corps and in 1920 entered General Electric's Test Course. Later that year he was transferred to the Generator and Motor Engineering Dept., and in 1923 was made assistant to the late Dr. Charles P. Steinmetz.

In 1926, Mr. Nickle collaborated with Dr. R. E. Doherty on a series of papers presented before the A.I.E.E. which made history among engineers. These papers dealt with the performance of synchronous machines and have served as a guide in the development of the largest power systems throughout the world.

The diamonds produced by Mr. Nickle were only dust-like particles developed to replace the expensive natural diamonds used in industry as abrasives, although he believed it was possible to produce larger ones. His other contributions include research in fluorescent lighting; the mass production of igniters; experiments with electric control for the welding of very

For Continuous War Production, Fit Boilers with
SONDERGLASS
Noted for high resistance to temperature strains, clouding and corrosion . .
A. W. CHESTERTON CO.
64 INDIA STREET ★ BOSTON, MASS.
1. CLEAR
2. REFLECTING
SONDERGLASS
SONDERGLASS comes in the two popular types illustrated: CLEAR for use where water column is well lighted; REFLECTING with red and white enamel background to make water level plain as a bull's eye.
Distributors in Principal Cities

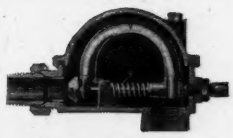
HAINES MEDIUM PRESSURE STEAM TRAPS

Speed Outputs — Save On Upkeep

Haines Steam Traps are widely used in Textile Dryers, Steam Presses, Hospital Equipment, Steam Kitchens, Air Conditioning Systems, etc. to provide larger outputs with same fuel, and save on plant upkeep.

As pictured at right, the Haines operating unit consists of a spring tempered tube which contains a volatile fluid hermetically sealed. So sensitive that a temperature change of one degree will operate valve.

Every Haines Trap can be examined under pressure at any time. All parts are interchangeable. And the trap is ready for business the instant steam is turned into the line. Write for descriptive folder.



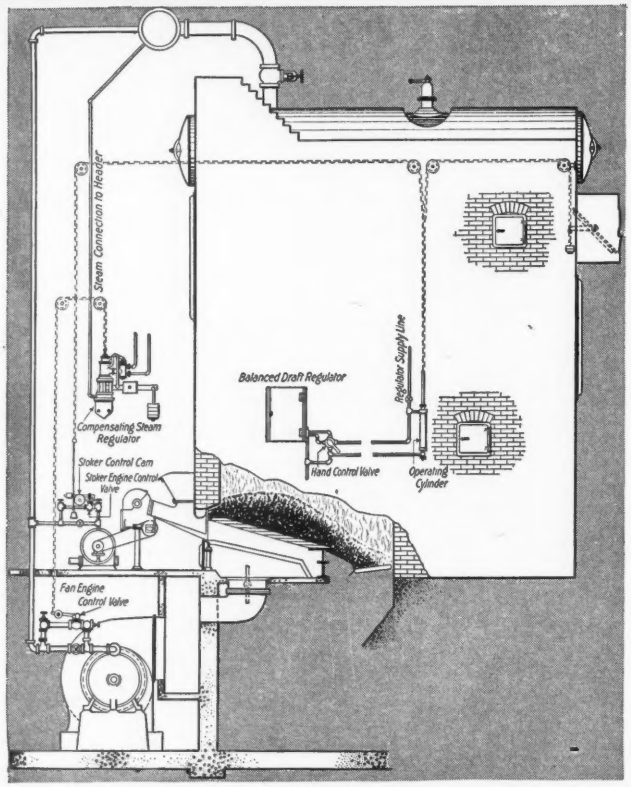
Haines Model 08 shown, handles pressures from 0 to 60 lb.; capacities from 500 to 3800 sq. ft. E.D.R.

WILLIAM S. HAINES & CO., 12th & Buttonwood Sts., PHILADELPHIA, PA.

Makers also of Radiator and Float & Thermostatic Traps

If you are changing to coal... get the most from it with...

Enco Balanced Draft



A PRACTICAL SYSTEM THAT AUTOMATICALLY CONTROLS

... FURNACE PRESSURE, STEAM PRESSURE, FANS AND STOKERS

You can get all the advantages of balanced draft with the Enco system which conforms to accepted practices of combustion control and yet is simple and easy to install and maintain.

It is adaptable to all methods of coal firing ... stokers of the underfeed, overfeed, spreader or traveling grate types, as well as hand-firing.

The apparatus is so free of complications and delicate mechanisms that it can be installed by your own maintenance crew and kept in operation with the greatest ease.

It may be either hydraulically or pneumatically actuated.

Ask for bulletin B.D. 43 on "Combustion Control" and get the facts on this practical, low cost system that has been in use for over 25 years on more than 1000 boilers.

THE ENGINEER COMPANY

75 WEST STREET (Enco) NEW YORK, N.Y.

fine wires of rare metals; and the development of a semi-portable therapy machine.

Mr. Nickle was a member of the Schenectady Edison Club and of the American Society of Electrical Engineers.

NEWS FROM THE FIELD

At its Twenty-Sixth Annual Meeting held in Buffalo, New York, on January 14, the National Association of Fan Manufacturers elected the following officers: J. M. Frank, president; J. M. Birkenstock, vice-president; and L. O. Monroe, secretary-treasurer.

At the regular monthly meeting of the board of directors of the American Institute of Mining and Metallurgical Engineers, held in January in New York City, Paul Dyer Merica, vice-president of the International Nickel Co. and Essington Lewis, Australia's recently appointed Director General of Aircraft Production, and Director General of Munitions were elected to Honorary Membership in the Institute.

Newly elected officers of the American Society of Heating & Ventilating Engineers for 1943 were installed at the 49th Annual Banquet, held at Hotel Gibson, Cincinnati, O., January 26. They are: president, M. F. Blankin, Philadelphia, Pa.; first vice-president, S. H. Downs, Kalamazoo, Mich.; second vice-president, Professor C.-E. A. Winslow, New Haven, Conn.; treasurer, E. K. Campbell, Kansas City, Mo.; and for members of the council elected for 3-yr. term are: John F. Collins, Jr., Pittsburgh, Pa.; Professor James Holt, Cambridge, Mass.; E. N. McDonnell, Chicago, Ill.; and Lt.-Comdr. T. H. Urdahl, Washington, D. C.

The membership elected five members of the Committee on Research for 3-yr. term, as follows: H. J. Rose, Pittsburgh, Pa.; L. P. Saunders, Lockport, N. Y.; Professor L. E. Seeley, New Haven, Conn.; Comdr. A. E. Stacey, Jr., Washington, D. C.; and C. Tasker, Toronto, Ont., Canada.

F. R. Phillips Power Station Dedicated

THE NEW Frank R. Phillips Power Station, an important addition to the Pittsburgh district's power-producing facilities, was dedicated January 5, by the Duquesne Light Co. in the presence of Army and Navy representatives and officials of the company.

The added 60,000-kw. unit brings the generating capacity of the company up to 624,000 kw., or about 25 per cent more than pre-war capacity. A similar unit, at the Reed Power Station, was completed in 1941.

With the new additions, the company feels that it has sufficient capacity to meet all demands of Pittsburgh district industry, even though this industry is being expanded rapidly to supply the goods of war.

The ceremony was opened by E. C. Stone, vice-president and general man-

SABOTAGE! DON'T ALLOW ANY OF YOUR MEN TO FORCE A VALVE

Failure to close off is usually caused by foreign matter lodged on the seat. Usually it clears away when the valve is opened part way to flush it.

Don't try force to close it off. That may scar disc and seat—giving you a permanent leak of another sort—and even though seats and discs require relatively little material, the metal they use is on the critical list. Waiting for new parts might cripple plant efficiency—sabotage, in wartime.

Where do your men apply grease, lead or paint to valve connections?

Instruct them when reassembling valves to their lines to put joint compound on the *pipe* threads—*not* on the valve threads from where the excess will be forced inside the valve and possibly onto the valve seat.

Before reassembly, see that valve and line are *both* blown out—or seats may be ruined by dirt and grit.

Write to Reading, Pa., general office, for copy of "VALVE DON'TS" —a poster for plant use that tells things NOT to do to valves.

READING-PRATT & CADY

MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

Reading, Pa., Atlanta, Boston, Chicago, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco

A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT, CONNECTICUT

A reproduction from an actual unretouched color photograph which illustrates the appearance of the gauge glass from directly in front.

"Our gauge glasses are perfectly illuminated"

"This is a modern power plant," explained the Chief, "carefully planned to the last detail. There's a light over every gauge glass, so they're very easy to read. A red lined glass would undoubtedly help in some plants, but it's unnecessary here."

The fact is, however, that PYREX Broad Red Line Gauge Glasses are easier to read *anywhere*, in a well-lighted or a poorly lighted situation. Hang a small calendar and a big one on the wall. The big one is easier to read from across the room, *in any kind of light.* So is a PYREX Broad Red Line Gauge Glass—incomparably easier to read from a distance. That's a safety feature, as you well know. And it's a feature that saves steps and saves time.

They also last longer, and that's your first demand. They're made of PYREX brand borosilicate glass—the same type of glass in which your wife likes to bake, and store things in the refrigerator—the same type of glass the chemical industry uses for piping because of its extraordinary resistance to corrosive action.

Next time, tell your jobber it's PYREX Broad Red Line!

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works, Corning, N. Y.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

ALLPAX

THE PACKING THAT "PACKS ALL"

. . . use it once and
. . . you'll use it always

THE ALLPAX CO., INC.

Mamaroneck, N. Y.

•

Distributors Everywhere

Here's the universal packing that can be used for any fluid or on any apparatus. One size packs all—economically, efficiently—tightly—simply.

Try ALLPAX and you, too, will be enthusiastic over its easy application and long wear. You don't have to remove old packing to repack with ALLPAX. Square cross section makes ALLPAX easy-filling in any stuffing box.

Try it and you'll always use it. Full details on request.

ager of Duquesne Light Co., who explained that the new plant has been in test operation for several weeks "and has demonstrated its ability to deliver power substantially in excess of its rating."

He declared that the plant operates at higher speed, and at higher steam pressures, than the older installations of the company, and that apparently it will need from 15 to 20 per cent less coal to produce the same amount of electricity.

The new plant uses powdered fuel, and an economical source of coal has been found in a strip mine about 15 mi. away and can be brought to the plant by river, rail or truck.

Despite wartime difficulties in getting equipment, the plant was finished in 18 mo.

Mr. McCance, president of the company, made a short address, accepting the plant for service to the community and the nation. He also officially named it the Frank R. Phillips Power Station, in honor of the late president of the company and Pittsburgh civic leader, who, he said, "had implicit faith in the future of this company and this community."

Mr. McCance declared that "in contrast to most industries, which have encountered severe bottlenecks in productive capacity due to the tremendous increases in war demands, the electric utility companies of the nation have been able to supply adequate electric power for the enormous industrial expansion which has taken place since the outbreak of the war in Europe."

He also stated that "some 90 per cent of the electricity generated by the company is essential to the war effort in the Pittsburgh district. Approximately 60 per cent of the total output is utilized for war production and some 30 per cent for essential non-military activities . . . such as street lighting, communications, hospitals, bakeries, food stores, necessary home illumination, etc.

P. J. Tyrell, oldest employe, in point of service, of the Power Stations Department, unveiled and read a plaque.

Brief addresses were made by Captain F. L. Oliver, U. S. Navy, retired, and by Frank B. Bell, chief of the Pittsburgh Ordnance District.

Midwest Power Conference Meets in April

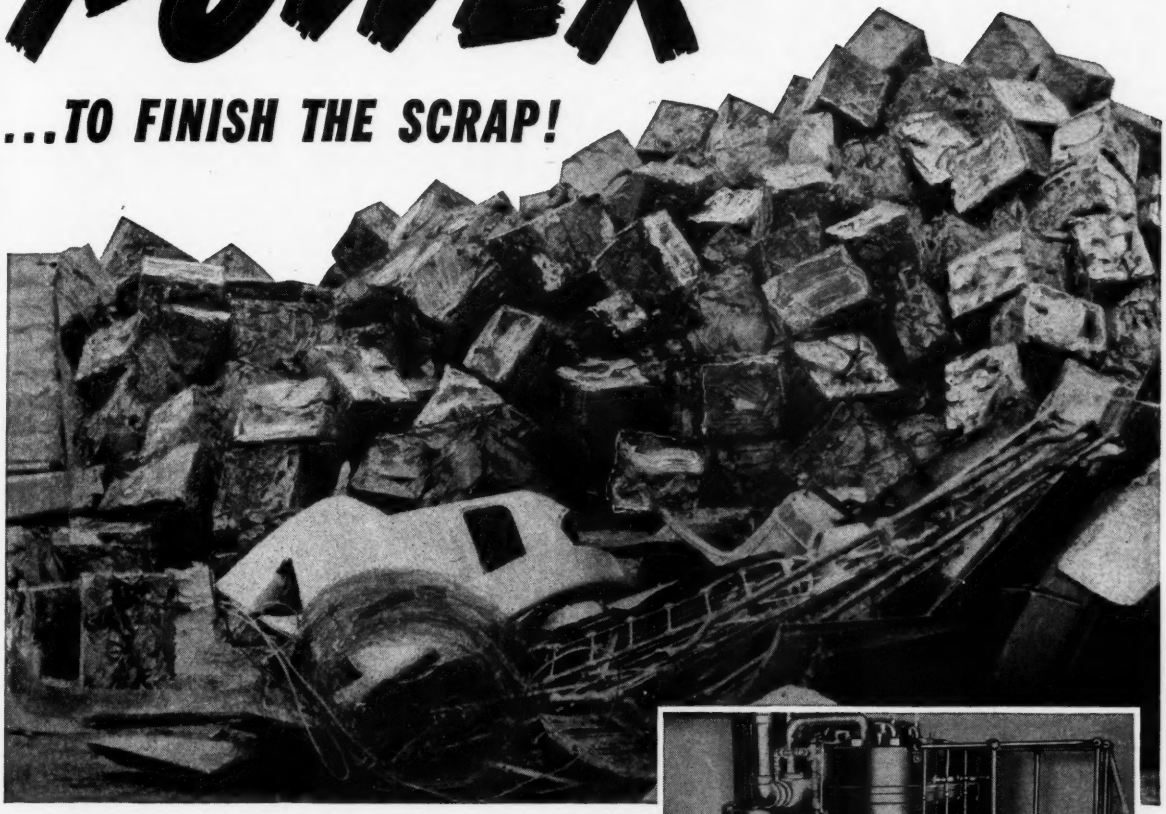
IN SPITE of the war, the Midwest Power Conference will hold its annual meeting this year on April 9 and 10 in Chicago. The meeting will probably be held at the Palmer House as usual, although definite plans will be announced later.

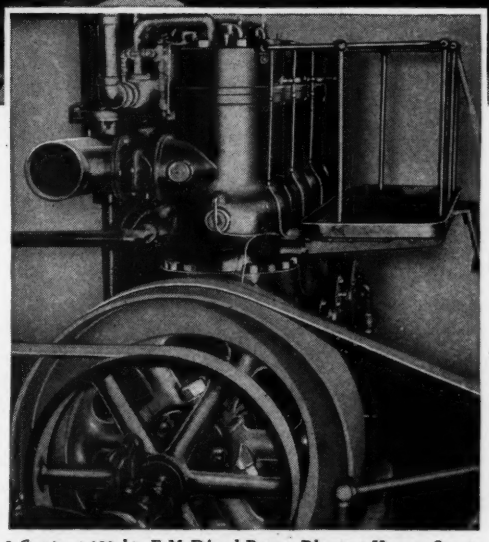
C. W. Kellogg, president of Edison Electric Institute, will be the keynote speaker, and Colonel L. Walsh, war chairman of the American Society of Mechanical Engineers, will deliver a talk on Logistics, the Science of Survival, at the All-Engineers' Dinner.

The Conference is being arranged under the sponsorship of Illinois Institute of Technology in cooperation with Iowa State College, Michigan State College, Northwestern, Purdue, Iowa, Illinois, Michigan, Minnesota and Wisconsin universities. The seven honorary fraternities included in the plan-

POWER

...TO FINISH THE SCRAP!





• *Compact 180-hp. F-M Diesel Power Plant at Harcon Scrap Metal Yard operates pump, generator, and compressor.*

SCRAP metal helps win wars! To simplify handling, the Harcon Iron and Steel Company compresses old metal into compact 400-lb. cubes. And it takes plenty of reliable power to do the job!

For "power to finish the scrap," a 180-hp. F-M Diesel is direct-connected to a pump which actuates a mammoth hydraulic press. It also drives an F-M generator which provides electricity for lighting.

If you require extra power for war production, use your priority to buy Fairbanks-Morse Diesels. They assure *low unit power costs* . . . plus no stoppage, no breakdowns, no letdowns — *now* or later! Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago, Illinois.

FAIRBANKS-MORSE

DIESEL ENGINES
PUMPS
MOTORS
GENERATORS
SCALES
WATER SYSTEMS
FARM EQUIPMENT
STOKERS
AIR CONDITIONERS
RAILROAD EQUIPMENT

Diesels

IF YOU SPECIFY INSULATION ACCORDING TO ITS RESISTANCE TO HEAT AND STABILITY (ROCK-WOOL'S 2 GREAT ENEMIES) THEN YOU WILL SPECIFY B-H BLACK ROCK-WOOL INSULATIONS

1400° of open flame eats right through white rock wools, but does not faze B-H black rock-wool. Moisture soaks into white rock wool and starts its disintegration, but B-H black rock-wool remains unaffected in any way.

B-H

FREE TO POWER-PLANT MEN

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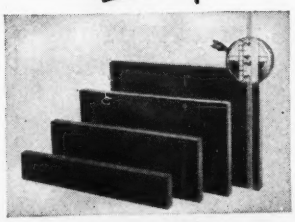

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ning and sponsoring are: Chicago sections of the American Institute of Chemical Engineers, American Institute of Electrical Engineers, American Institute of Mechanical Engineers, American Society of Mechanical Engineers, Illinois sections of the American Society of Civil Engineers, American Society of Heating and Ventilating Engineers, and the Western Society of Engineers.

J. A. Krug, Director of Power

WAR PRODUCTION BOARD Chairman Nelson announced on Jan. 22, 1943, the creation of the Office of Power Director with the appointment of J. A. Krug as its head to take over complete responsibility within the WPB for electric power, gas, water and communications.

The Office of Power Director will include the present WPB Power Division and the Communications Equipment Division, functions and responsibilities of the Facilties Bureau and the Resources Agencies, insofar as they deal with electric power, gas, water, and communications. Mr. Nelson said that on all policy matters the Power Director will report directly to him, while reporting as to administrative matters to the Program Vice-Chairman. Pursuant to determinations of the Requirements Committee, his authority includes approval of projects allocation of materials and critical components, within the power and communications fields and allocation and rationing of utilities services. The Office of Power Director will have the status of a Claimant Agency before the Requirements Committee.

"Maximum war production in the last half of 1943," said Mr. Nelson, "is dependent upon carrying out the expansion of power, gas and other utilities as planned by the War Production Board. This will require the most careful scheduling, since power, gas, and other utility facilities require much of the same kind of equipment and materials as the other urgent programs—rubber, high octane gasoline and ships.

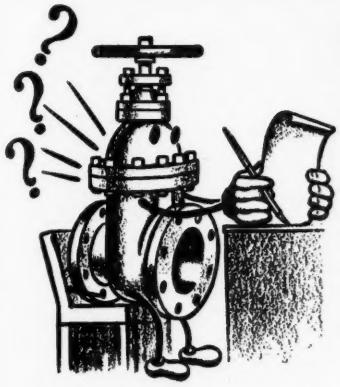
"The purpose of this arrangement is not to put the programs in competition with each other, but to fit all of them together into an orderly and integrated construction program which can be successfully carried out in the time which we have available."

Alabama Power Co. to Expand

THE ALABAMA POWER CO., Birmingham, Ala., is arranging a fund of about $4,700,000 for expansion and improvements in power plants and system in 1943. The entire program will be connected with war-related developments in company territory, and will cover completion of certain work begun in 1942.

Power station work will consist primarily of expansion in Chickasaw and Gorgas generating stations, both steam-electric type, where programs are now in progress and scheduled for

AN OCCUPATIONAL QUESTIONNAIRE FOR GATE VALVES



The country's all-out war effort demands that every man, machine and piece of equipment be put to work at the job for which he or it is best suited. Valves are no exception. The many different types of valves in existence today have each been designed for a particular job . . . and they should not be wrongly applied. Here are a few questions and answers in an occupational questionnaire for GATE VALVES.

QUESTION: When should GATE VALVES be used in preference to GLOBE and ANGLE VALVES?

ANSWER: GATE VALVES are preferable for lines on which it is important to minimize resistance to flow. They are necessary where complete drainage of the pipe must be provided. GATE VALVES are suited primarily for locations where valves are to be generally wide open or tight shut because, when used for throttling, the high velocity of flow tends to erode the seating surfaces.

QUESTION: Where are WEDGE GATE VALVES used?

ANSWER: WEDGE GATE VALVES (Fig. 1) are used where gummy liquids are handled, and are preferred for steam service by some engineers and operators.

QUESTION: What are the applications for DOUBLE-DISC GATE VALVES?

ANSWER: DOUBLE-DISC GATE VALVES (Fig. 2) are preferable where liquids containing grit are to be handled, because the flexibility of their operating mechanism enables one disc to seat tightly if grit is caught on the other seat and also because the discs and seats are more readily refaced than those of WEDGE GATE VALVES.

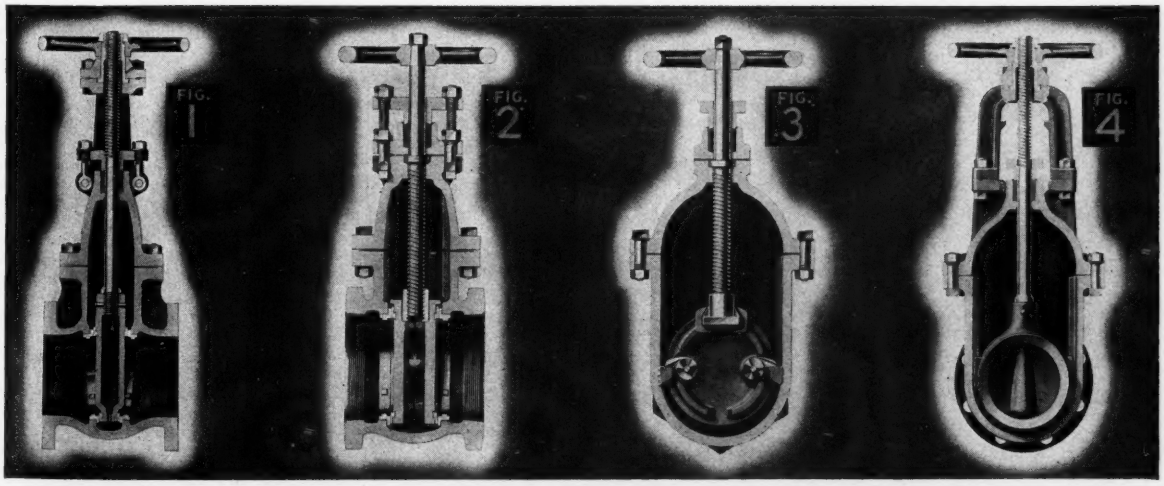
QUESTION: What are the advantages of NON-RISING STEM GATE VALVES?

ANSWER: NON-RISING STEM GATE VALVES (Fig. 3) are usually tighter at the stuffing box than gate valves with rising stems and do not require as much head room.

QUESTION: When should OUTSIDE-SCREW-AND-YOKE GATE VALVES be used?

ANSWER: OUTSIDE-SCREW-AND-YOKE GATE VALVES (Fig. 4) should be used when it is necessary to know at a glance whether the valve is open or shut. The outside screw is also preferable with corrosive fluids, because the stem threads are out of contact with the fluid handled.

If YOU have any other questions you would like to ask about the selection of valves, write to us. As Kennedy makes a complete line of standard valves, you can be sure of receiving unbiased help. For full description of Kennedy valves, pipe fittings and fire hydrants, send for 240-page Kennedy Catalog.



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VALVES • PIPE FITTINGS • FIRE HYDRANTS
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completion this year. At the Chickasaw station, near Mobile, Ala., work consists of the installation of a 40,000-kw. turbine-generator unit and auxiliary equipment, to develop a rating of 80,000 kw. for the plant. This project is expected to be completed at an early date, with the new unit to be placed in immediate service. At the Gorgas, Ala., station, work is under way on installation of a new 60,000-kw. turbine-generator, to advance rated capacity of station to 190,000 kw., scheduled for completion next summer.

With these extensions, the company will have an installed generating capacity at all plants of 703,200 kw., of which 287,700 kw. will be steam-electric, and remainder hydroelectric. The Gorgas station is located in a coal-mining area, and a new mine is being developed by the company at that place, to be equipped for a rated output of about 350,000 tons per annum. This plant will be used for fuel supply for the Gorgas No. 1 and No. 2 generating stations, in addition to other company service. Complete modern mining machinery will be provided for operations at the properties. Other 1943 work will include extensions in certain transmission lines, as well as relocation of other high-tension lines, expansion in distribution systems, power substations and other structures.

AN IMPORTANT ANNOUNCEMENT TO ALL TUBE CLEANER BUYERS

Because it has become impossible for us to meet the ever increasing demand for Wilson Tube Cleaners and Wilson tube cleaning accessories in our plant at 47-28 37th Street, Long Island City, N. Y., we have purchased the building shown in the above photograph.

In our new home we will have available over three and one half times the floor space we had in our former plant. We have installed many new high speed machine tools and the greatly increased production capacity which these additional machines are giving us enable us to make more Wilson Tube Cleaners and accessories and also to make quicker shipments.

Write for the name of our representative nearest to you or ask for a copy of our NEW forty-page catalog which fully describes and illustrates the complete line of Wilson tube cleaning equipment.

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W. P. Murphy Wills $20,000,000 to Northwestern University

IN EXCESS of $20,000,000 will come to Northwestern University, Evanston, Ill., from the estate of Walter P. Murphy, manufacturer of railway supplies, who died on December 16. Mr. Murphy specified that the fund should be used to develop, maintain and operate the Technological Institute of Northwestern University, which was founded in 1939 with a gift of $6,735,000 from the Walter P. Murphy Foundation. As much as possible of the principal is to be held intact and used for endowment of the Institute, but the trustees of the University have been empowered to spend portions of the principal from time to time and all or any part of the annual income for additional buildings, equipment, professorships, scholarships, books, research, and such other purposes as the trustees think necessary to the proper operation of the Institute.

U. S. Power Plants Earnings Grow

A TOTAL of $7,680,000 has been returned to the people of the United States during the past 12 mo. toward liquidation of their investment in Bonneville and Grand Coulee Dams and the 2000-mi. Federal transmission grid.

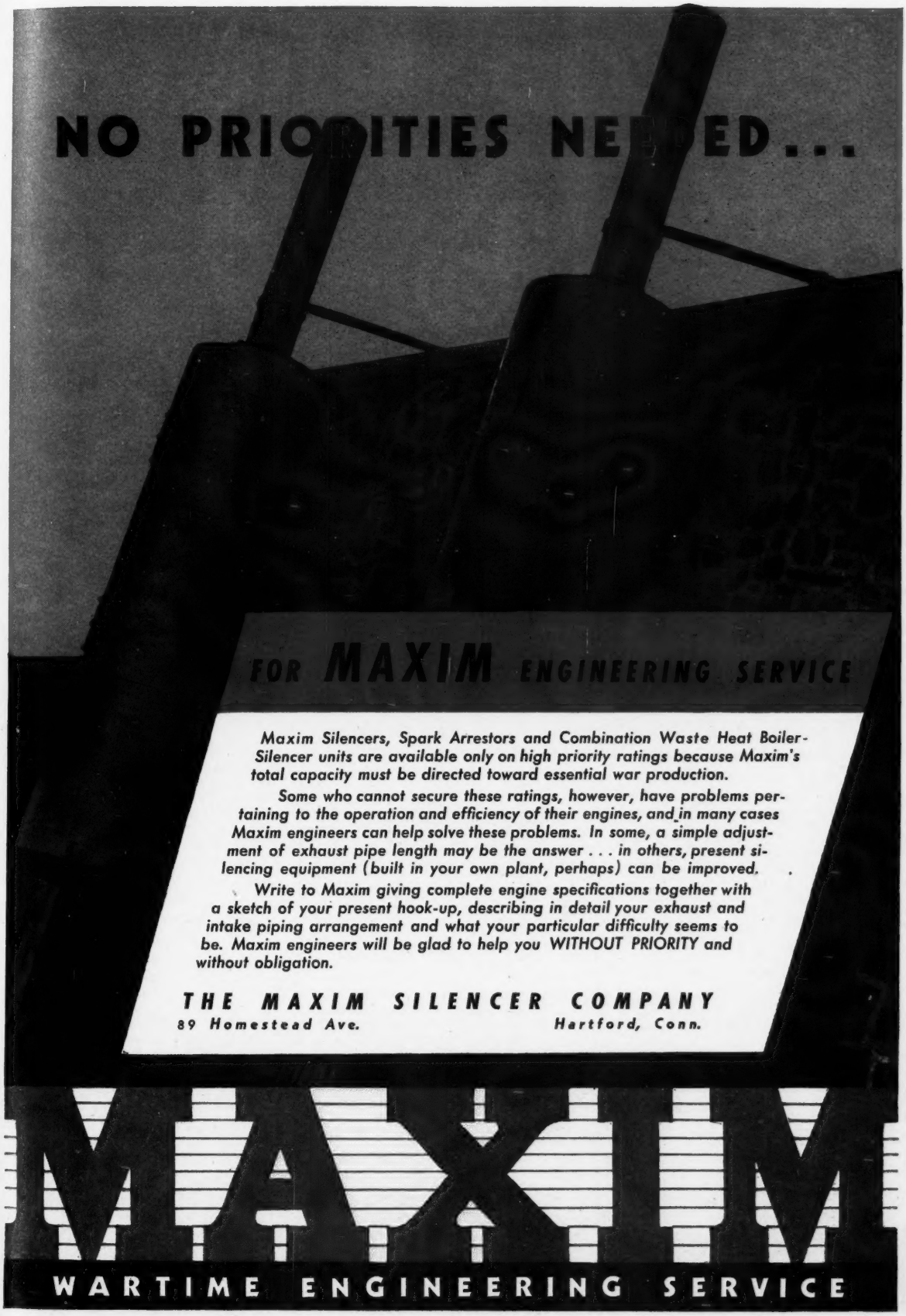
Bonneville Power Administrator Paul J. Raver, whose agency is required by law to dispose of Bonneville and Grand Coulee power, said this revenue was $4,215,000 more than that collected from the sale of Columbia River power in the year 1941.

Mr. Raver said that on the basis of present contracts and commitments, Bonneville's annual power sales will be at the rate of between 12 and 14 million dollars by next June. By the end of calendar year 1944, the rate will have jumped to about 18 million dollars annually.

Actual power deliveries by the Bonneville Administration during the calendar year totaled 3,473,000,000 kw-hr.

Ross Dam Power Project to Expand

THE DEPARTMENT of City Lighting, Seattle, Wash., has taken bids and will begin work soon on construction of a second section of the Ross power dam project, to provide additional hydroelectric power for municipal service. In addition to dam construction, the immediate project will include work at the Ruby reservoir for increased water supply for station use, and is estimated to cost $10,164,760, of which $1,864,750 will represent a federal grant. A priority rating of AA-2X has been given the project by WPB. At a later date, work will be placed under way on hydroelectric power development, representing another step in the project. Engineering division of lighting department is in charge, with W. B. Wolfendale as supervising engineer; C. E. Shevling, senior engineer, in charge of design; H. F. Faulkner, concrete technician; and E. R. Hoffman, superintendent of the department. B. E. Torpen, U. S. District Engineer Office, Pittock Block, Portland, Ore., is consulting engineer for the project.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Maxim Silencers, Spark Arrestors and Combination Waste Heat Boiler-Silencer units are available only on high priority ratings because Maxim's total capacity must be directed toward essential war production.
Some who cannot secure these ratings, however, have problems pertaining to the operation and efficiency of their engines, and in many cases Maxim engineers can help solve these problems. In some, a simple adjustment of exhaust pipe length may be the answer . . . in others, present silencing equipment (built in your own plant, perhaps) can be improved.
Write to Maxim giving complete engine specifications together with a sketch of your present hook-up, describing in detail your exhaust and intake piping arrangement and what your particular difficulty seems to be. Maxim engineers will be glad to help you WITHOUT PRIORITY and without obligation.
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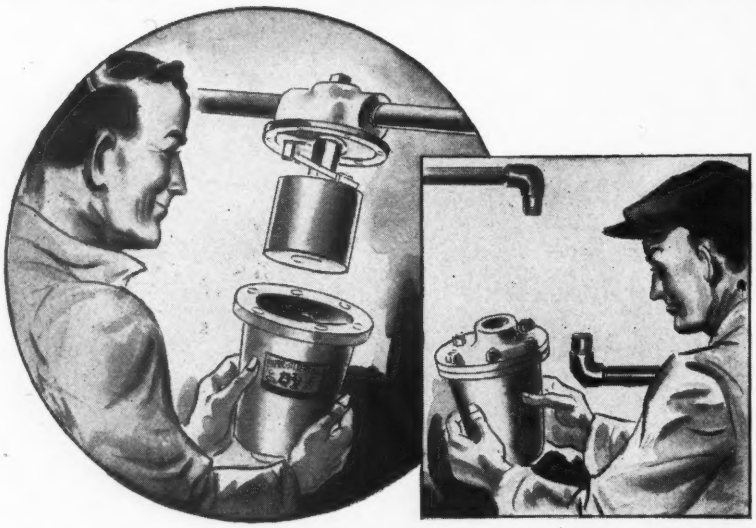
Wartime maintenance no problem for SUPER-SILVERTOP USERS



THE VITAL NECESSITY of keeping power flowing makes steam trap maintenance an important subject today. Now, when steam-using equipment is being called upon to deliver maximum war work, steam traps must be inspected regularly, kept clean and in efficient working condition. With Super-Silvertop Steam Traps inspection and maintenance is no problem.

The Super-Silvertop user finds that by releasing a few bolts he can remove the casing, inspect his trap, and clean or replace parts, all *without removing the trap from the line.* Compare this saving in work and lost time with that of a trap that has to be removed completely from the line for maintenance or inspection.

More than that, remember that Super-Silvertops are installed either straight-in-line or as an elbow with a saving of 60 minutes per trap and using from 6 to 13 parts less. Send for the book "How To Choose a Steam Trap" giving complete details on steam trap selection, installation, operation and maintenance.

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Study of Cast Iron in High Temperature Operation

IN ACCORDANCE with its policy of relieving overburdened industries by encouraging the use of more readily available substitute materials whenever possible, the WPB has authorized the War Metallurgy Committee, National Academy of Science, Washington, D. C., with the cooperation of the American Foundrymen's Assn., to conduct a field research project to study the possibility of utilizing cast iron in operations at high temperatures (in excess of 450 deg. F.). T. E. Barlow, Vanadium Corp. of America, 2440 Book Bldg., Detroit, Mich., and C. O. Burgess, Union Carbide & Carbon Research Laboratories, 4625 Royal Ave., Niagara Falls, N. Y., have been appointed to obtain the desired data.

It is requested that engineers, foundrymen, field service men and others who have information on performance records of cast iron at high temperatures, successful or otherwise, get in touch with either of the two men mentioned above. In this way they will be making a valuable contribution to the ferrous industry and to the war effort. The information obtained during this study will be reported statistically and the actual details of operation will be kept confidential when desired.

Maintenance of Distribution Transformers

TO CONSERVE critical materials—copper and steel—for the war effort, Public Service Electric & Gas Co. is converting and repairing a large number of its electric transformers yearly to meet the requirements of the company's electric system. Translated into material, it means the saving of approximately 200,000 lb. a year. The work is being carried on in the company's enlarged shop in Irvington, N. J.

There are approximately 48,000 transformers in the Public Service system. They consist of about 90 per cent copper and steel. In prewar days, the general function of the shop in Irvington was the general repair of the transformers taken from the lines. It was a simple process generally consisting of replacing connecting leads and porcelain insulating parts, cleaning the coils and painting the tanks.

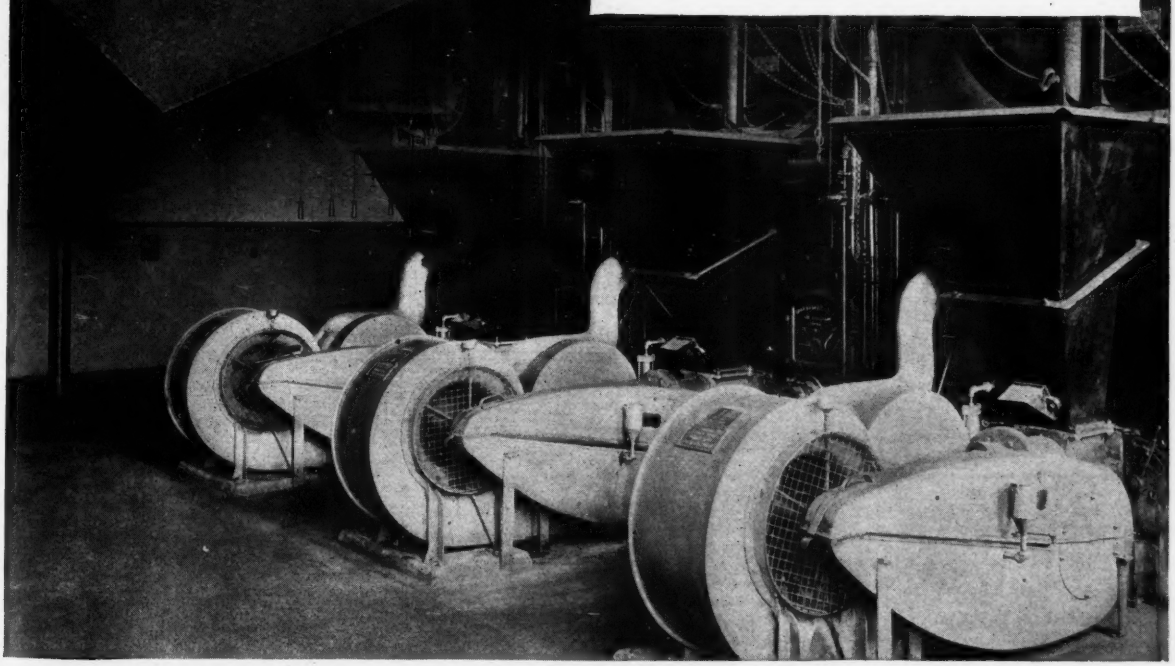
A large changeover program in the underground system of Public Service started before the war, created an unusable surplus of small size submersible transformers. At the same time increased use of electricity in the home brought about a demand for small sizes suitable for pole mounting. A program to convert the surplus of submersible units into the pole-mounting type was instituted. The change to overhead operation called for different tanks suitable for pole-mounting. Use was made of old tanks from burned out pole mounted units, in addition to some new tanks.

The change in the underground system also created a surplus of large size submersible units which were of no use in their original form in the new system and were too heavy to hang on poles. A change in coil connections, a rough machining job on the tank, and the addition of a small bronze plate converted these transformers to the

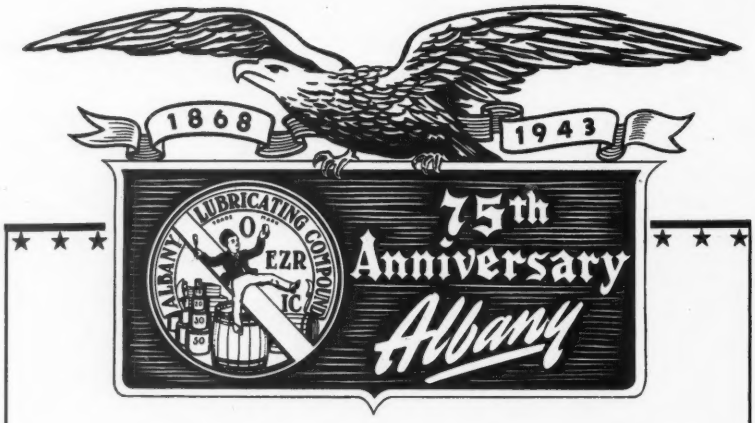
Crystolon Brick FOR CONVERSION FROM OIL TO COAL

Many plants converting their boiler furnaces from oil to coal are requesting *Crystolon* (silicon carbide) brick — especially at the clinker line and bridge wall. *Crystolon* brick are made to "stand the gaff" at high temperatures, and their ruggedness makes them resistant to the abrasive action of ash and the motion of the fire bed. *Crystolon* brick are so dense as to prevent molten ash from taking hold by penetration and they resist the erosive action of slag. The use of *Crystolon* brick guarantees uninterrupted peak operation.

NORTON COMPANY
WORCESTER MASSACHUSETTS



NORTON ELECTRIC FURNACE FUSED REFRACTORIES



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new system. These two programs are still in progress although the system change itself has been stopped for the duration.

The tanks of the majority of the largest subway transformers have thin corrugated steel sides which are imbedded in cast iron bottoms and top rings. These tanks are subject to corrosion by soil water particularly for about 2 in. above the base. Holes which often develop in this area render a tank useless. This was not much of a problem in prewar days or while a surplus existed. The leaky units were merely set aside. The war, however, made it necessary to place even these in service. Small holes are now patched with a special solder. When the sides are so badly corroded that soldering is not practical, the entire corroded portion near the bottom, together with the heavy cast iron base, is cut off and a new bottom of steel plate is electrically welded in place. Although this is a difficult task calling for first-class workmanship, the amount of iron in the old base which is available as scrap is actually several times the weight of steel used for the new bottom. An offshoot of this tank work was the "tailoring" of smaller pole type tanks to fit coils of different size and manufacture. These tanks are made of sheet steel and changes are simply cutting and welding jobs with oxy-acetylene torch.

The oil in all transformers brought into the shop is carefully filtered to remove all traces of water and carbon. Tanks are painted with special paint to arrest corrosion. All this additional repair work has not relaxed the standards of the company which are in themselves the customer's assurance of safe and dependable service. Every transformer leaving the shop must meet the same electrical tests as a new one. If it fails to meet those tests, the usable parts are salvaged and the rest started on its way to some war factory as scrap.

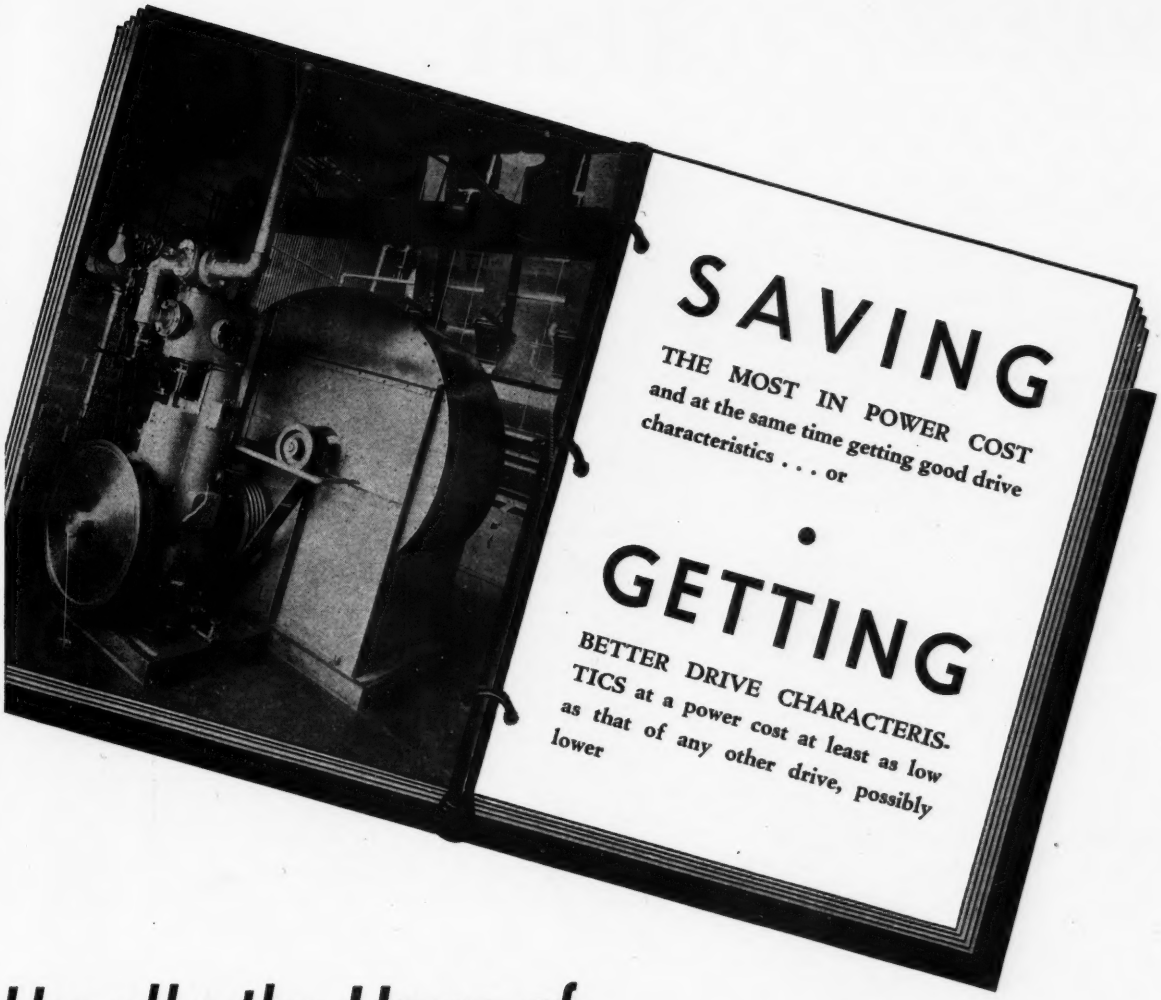
Continue Work on Five Government Projects

POWER installations are continuing on five exempted Bureau of Reclamation projects in the West. These projects were specifically exempted by the War Production Board from its order stopping Federal project construction.

These projects will add 778,600 kw. to the war power supply by January, 1944. The installations are being made at Grand Coulee Dam, Washington, and Boulder Dam, Arizona-Nevada, and new plants are to go into operation at Parker Dam, Arizona-California, Green Mountain Dam, Colorado, and Shasta Dam, California.

Commissioner John C. Page summarized, in a report to Secretary Ickes, the Bureau's power developments which are specifically excepted in a letter from Chairman Donald M. Nelson of the War Production Board, relating to a halt in project construction. This letter also directed that construction activities be shut down on all projects which Mr. Nelson held would not contribute directly to the prosecution of the war.

At Grand Coulee Dam in the Pacific Northwest, by the end of 1943, a total of 474,000 kw. will be added to the present capacity of 344,000 kw. Of the new installations, 150,000 will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• CLEANLINESS: It is essential to guard against impurities gaining entrance and contaminating the oil. OIL TEMPERATURE: As oil temperature rises, the tendency of the oil to oxidize and deteriorate is accelerated — we suggest that a careful check be kept on your oil temperature. OIL PRESSURE: The oil pressure provides an index to the proper operation of the system as a whole—all pressure changes, sudden or gradual, should be investigated. OIL LEVEL: To neglect the oil level in bearings or supply tanks is to jeopardize all other good work done toward maintaining correct lubrication. FOAMING: Breakdown of generator insulation, short circuits, etc. result through escaping oil due to foaming. On some installations it has been found that a slight reduction in the pressure at which oil is circulated will be beneficial—on others the correction has been accomplished by reducing the flow of water through the cooler and circulating the oil at a slightly higher temperature. Lack of oil is a likely cause of foaming. Adding too much new oil to the system at one time is another cause. SLUDGE: Possibility of this formation is minimized by using a high grade oil and keeping system free from impurities. DRAINING: Regular draining and renewal of the lubricating charge is essential to continued efficiency in lubrication.

Our Bulletin T-120 gives you details on all these points and makes other valuable suggestions.

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go on the line next month with the installation of two generating units originally ordered for Shasta Dam in California. The remainder in three units of 108,000 kw. each in July, September and November of 1943.

At Boulder Dam two generating units of 82,500 kw. each will increase the capacity of this plant to 1,034,000 kw. One of the new units was added in December, 1942 and another will be added in December, 1943.

The three new power projects to go into operation are:

Parker Dam Power Plant, on the Colorado River 100 mi. below Boulder Dam, will bring in 120,000 kw. by May 1943. Two units will come in next month, a third in December, and a fourth in May.

Green Mountain Dam of the Colorado-Big Thompson project in Colorado will go into operation in the late winter of 1943 with 21,600 kw.

Shasta Dam, of the Central Valley project in California will go in January, 1944 with two units totaling 150,000 kw. A 97-mi. transmission line from Shasta Dam to Oroville, California, is authorized as a part of the Shasta Dam development.

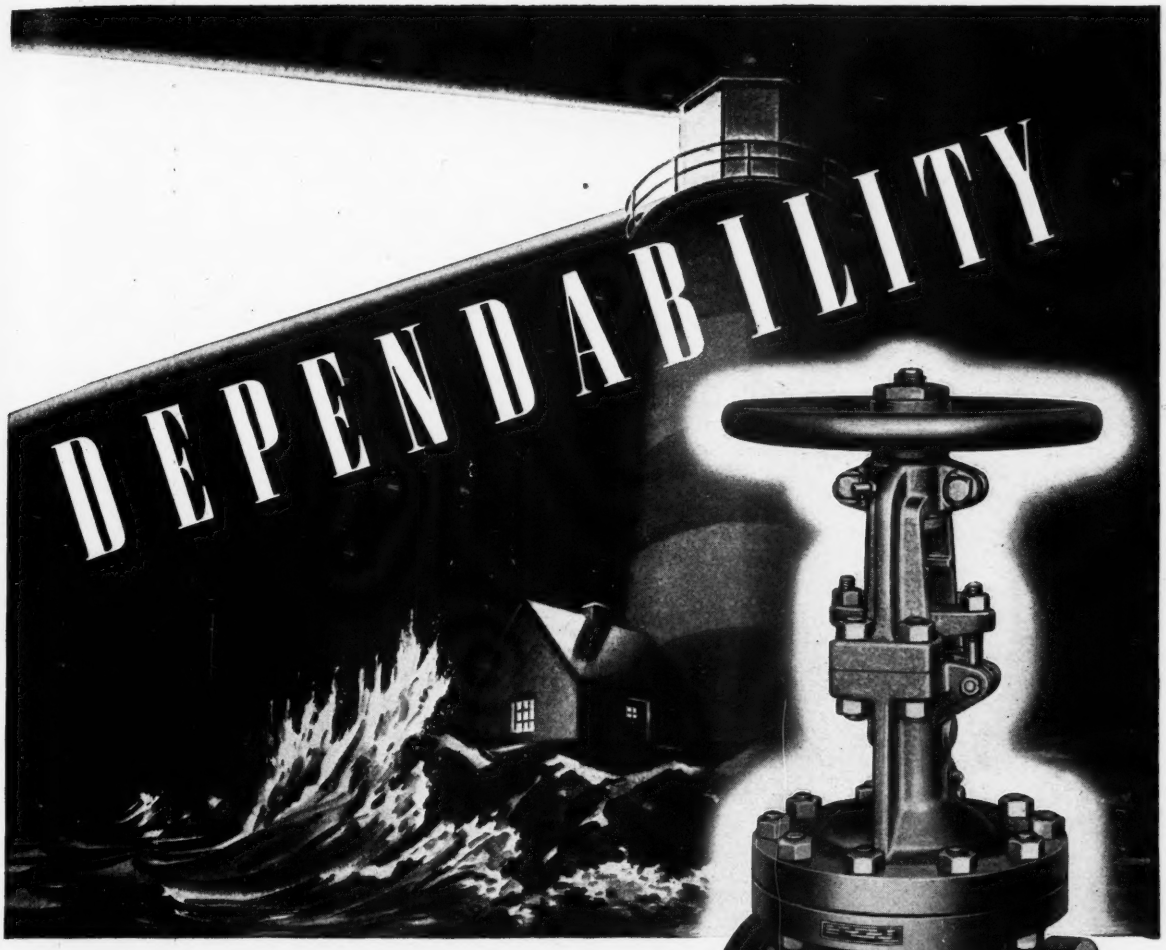
The installations Commissioner Page listed are exclusive of the projects included in the WPB announcement of October 28, which referred to orders for the discontinuance of construction on Keswick Dam of the Central Valley project, Davis Dam on the Colorado River, and Anderson Ranch Dam in Idaho. Also included was an order to cease on the remainder of the Colorado-Big Thompson project, including the Continental Divide Tunnel and prospective power developments in Northeastern Colorado; the right (east) power house at Grand Coulee where 324,000 kw. had originally been planned for installation in 1945 and a fifth unit originally planned for Shasta Dam. The total capacity affected by the WPB shut-down order is 865,000 kw.

War-Time Lamp Bulbs Are Different

FEW OF OUR everyday products have undergone so complete a wartime change in materials as electric lamps. The changes are not obvious, so few people are aware that any revolution has occurred. Yet, everything in the makeup of incandescent and fluorescent lamps has been changed except the tungsten filaments. The brass screw base has been replaced with brass-plated iron which on a million filament lamps saves about 9500 lb. of brass. Two small drops of solder formerly fastened the lead-in wires of filament lamps to the brass shell and consumed 60 tons of tin yearly. Now this tin is saved by use of a lead-silver alloy solder, claim Westinghouse experts.

The fluorescent lamp saves metal by utilizing a new kind of glass. Originally made with glass containing lead oxide, manufacturing techniques have been changed to permit use of lime glass thus saving 179,000 lb. on a million average-size fluorescent lamps. At present, engineers are redesigning the base of the fluorescent lamp to provide a one-piece plastic assembly; the object is to save vital nickel now used in the collar.

(*Continued on page* 156)



In the vast field of Power, Powell Valves are famous for Dependability

It's not by accident that Powell Valves have an outstanding reputation for dependable performance in the all-important field of Power.

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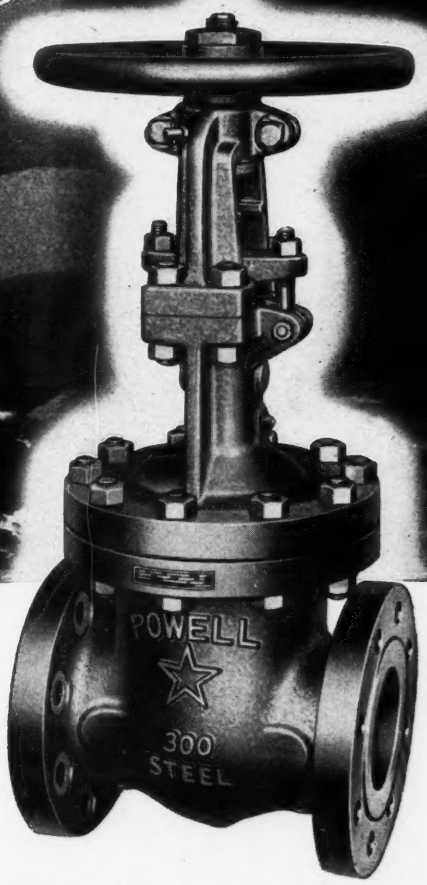

Fig. 3003—Class 300 pound Cast Steel Gate Valve. Has outside screw rising stem and two-piece bolted flanged yoke. Available in sizes from 1¼" to 24" inclusive, with either flanged or welding ends.

The complete Powell Line of Cast Steel Valves includes Globes, Angles, Checks, Gates, Non-returns, etc., for 150, 300, 400, 600, 900, 1500 and 2500 pounds W. P. to meet the demands of American Industry for dependable flow control equipment to handle ever increasing pressures and temperatures.

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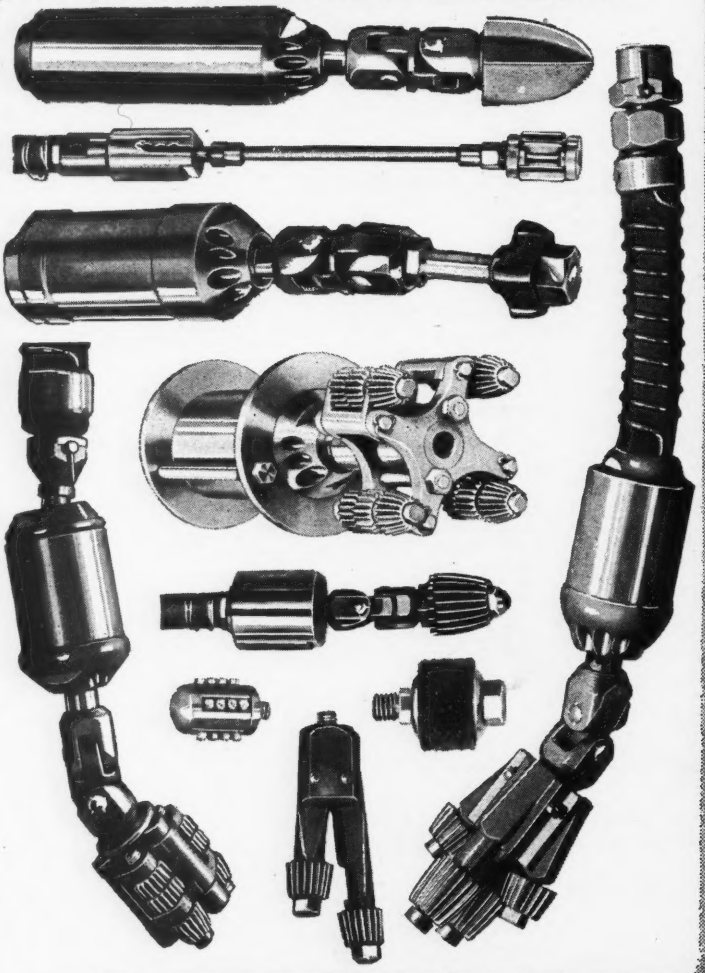

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Helpful Bulletins

BOILER PLANT EQUIPMENT

1 Steam Generators—4-page Bulletin 27 discusses Union H-type steam generators, self-contained units with steel-cased settings. Details of construction and principles of operation are shown by many photographs and diagrams. Union Iron Works.

2 Stokers—8-page catalog discusses operation, advantages and applications of water-cooled Taylor stoker. Includes photographs and diagrams and lists representative installations. American Engineering Co.

3 Tube Cleaner—6-page folder describes the Vibratap, a vibratory cleaner which removes scale by mechanical means that breaks hold of deposit on metal. Also illustrates Vibratap for both fire-tube and water-tube boilers. Brunt Equipment Co.

4 Automatic Coal Scales—New Catalog R-21240 tells about the Richardson automatic coal scale which provides continuous and accurate records of the amount fed each boiler. Contains helpful boiler room pictures and data. Richardson Scale Co.

5 Boiler Operation—20-page Bulletin No. 16, entitled "How to Safely Stretch Steaming Capacity," explains how proper use of metering and control equipment stretches capacity, avoids shutdowns, insures safety, furnishes data for fuel comparison, reduces fuel consumption, and maintains efficiency while new operators are trained. Bailey Meter Co.

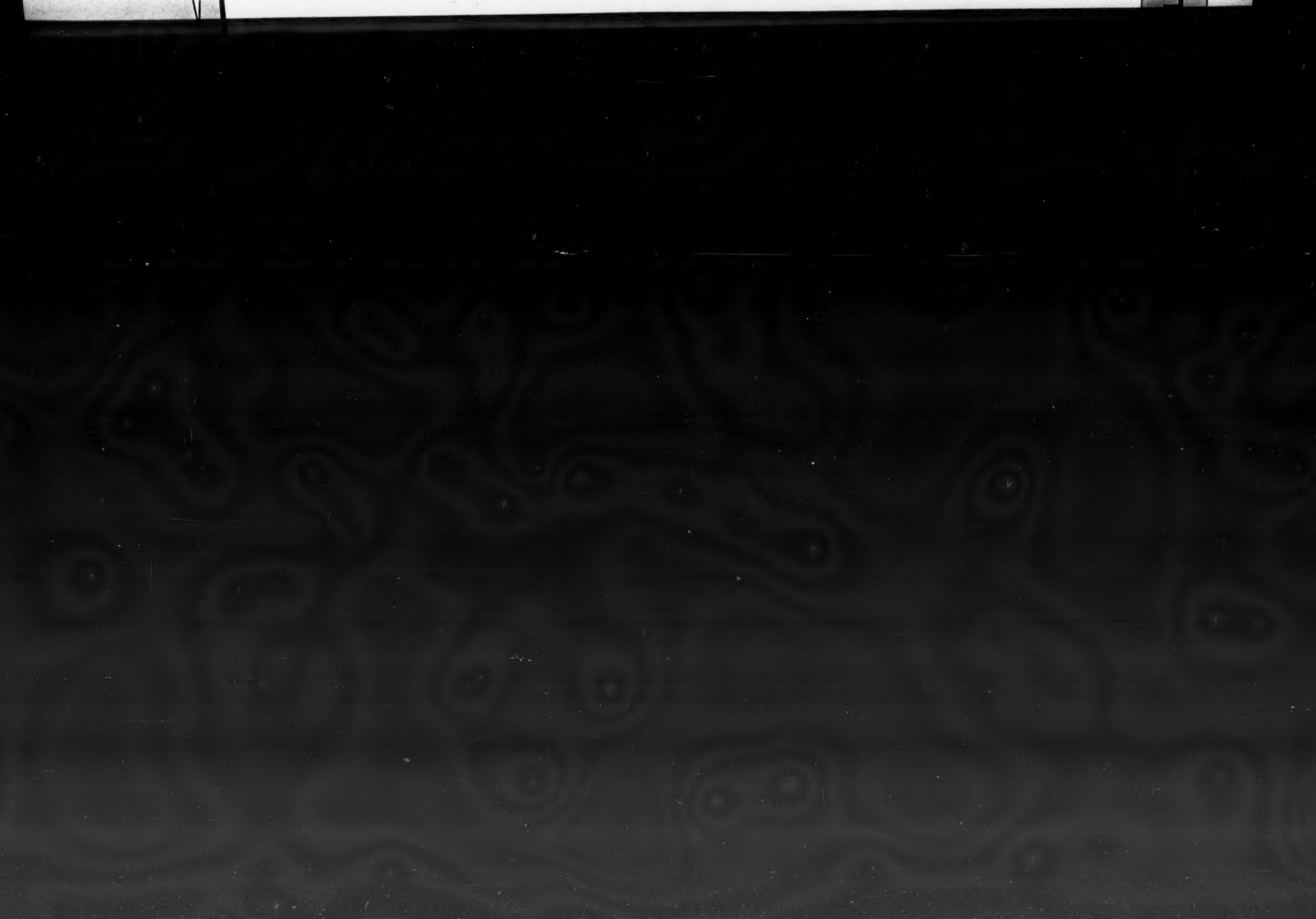
6 Heavy-Duty Stokers — 20-page bulletin features Iron Fireman Poweram heavy-duty stokers for boilers developing up to 400 hp.; outlines features of these stokers, shows actual installation photographs and lists representative users. Iron Fireman Mfg. Co.

7 Integral Furnace Boiler — Illustrated Bulletin G-34 gives complete data on integral furnace boiler, either stoker firing or oil burning. Can be quickly converted to burn whichever is the more economical fuel. Outstanding features of this unit are described in detail and cross sectional views show typical installations. The Babcock & Wilcox Co.

8 Furnace Linings — New descriptive bulletin tells how Armor-Clad coatings seal furnace linings against flame and slag penetration, lengthen furnace life 50% or more, keep boilers in operation longer. Armor-Clad Co.

9 Spreader Stoker Firing—In reprint form is article "Recent Developments in Spreader Stoker Firing" as presented by R. L. Beers at December A.S.M.E. meeting. Tells how method successfully handles inferior grades of fuel having ash with low fusion temperatures; contains test results. Detroit Stoker Co.

10 Combustion Control Handbook—A new edition of the Hays Combustion Meter Catalog has just been issued. This Bulletin 42-550 explains the purposes of a combustion meter and the relation of carbon dioxide to combustion efficiency. A schematic explanation is given of the operation of a combustion meter. Sent free on request. The Hays Corp.



HELPFUL BULLETINS

Practical answers to many wartime problems of plant operation and maintenance are found in the engineering bulletins offered by manufacturers. For your convenience we publish the following summary of helpful literature mentioned in this and recent issues of POWER PLANT ENGINEERING. To obtain copies of the bulletins and catalogs described, simply indicate the paragraph numbers on postcard below, detach and mail.

ELECTRICAL EQUIPMENT

11 AC Generator—16-page Bulletin B-3028 describes large ac generators, from 25 to 2180 kv-a., for diesel-engine drive, to be used in municipal lighting plants and for industrial emergency power. Discusses rotor and stator constructions, emphasizing effective ventilation, insulation tests. Westinghouse Electric & Mfg. Co.

12 Electrical Connectors — Pocket-size catalog, 48 pages, illustrates 75 electrical connector types with catalog listings of important connector sizes. Also contains helpful wiring data. Burndy Engineering Co.

13 Motor Care—New handbook entitled, "A Guide to Wartime Care of Electric Motors" meets pressing problem of how to keep motors running under continuous service conditions. Taking a fresh slant on care of motors under war conditions, the book should prove of value to engineers and maintenance men and in training new operators. The handbook is an impartial study of all motor types. Allis-Chalmers Mfg. Co.

14 Fluorescent Lighting—A new 30-page catalog and handbook contains information on selecting the proper types and quantities of fluorescent lighting fixtures for a particular project. Included are illustrations of over thirty models with complete technical specifications, list of Recommended Minimum Standards of Illumination, and general engineering and maintenance information. Sylvania Electric Products, Inc.

15 Power Distribution — 16-page Booklet GEA-3758 explains basic principles of load-center power distribution for industrial, naval and military projects, shipyards, central stations, and commercial buildings. Also lists chief advantages of system, illustrates available circuit arrangements, and shows typical installations of load-center substations. General Electric Co.

16 Safety Switches—Safety switches for industrial applications are illustrated and described in a new bulletin, No. 500. Included in the bulletin are specification tables for all types available. Square D Co.

17 Electric Welding—Flexarc alternating current welders, with current ratings from 100 to 500 amp., are illustrated and described in a 12-page booklet, B-3136. Included in the booklet is a table of specifications covering the four models available. Westinghouse Elec. & Mfg. Co.

17-B Motor Control—Synchronous-motor control is the subject of a new illustrated, 12-page bulletin (GES-1724D). Starting, accelerating, synchronizing, normal running, pull-out, and undervoltage protection as performed by both the magnetic and semi-magnetic types of full- and reduced-voltage synchronous-motor controls are described in considerable detail. General Electric Co.

FANS, PUMPS AND COMPRESSORS

18 Pump Manual — "The Stationary Instruction Manual" is a 12-page bulletin, well illustrated and covering in detail the installation, operation and maintenance of small pumps. Text covers such points as installation, foundation bolts and grouting, alignment, suction lines, piping, relief valves, priming, starting, rotation, packing, dismantling and reassembly. Quimby Pump Co.

19 Rotary Compressors — 16-page Booklet C5 describes Fuller rotary compressors and vacuum pumps. Many line diagrams, cross-sections, photographs of machines, typical installations and numerous tables are contained. Fuller Co.

20 Wartime Care of Centrifugal Pumps — Abundantly illustrated, Allis-Chalmers' new maintenance handbook makes specific recommendations for putting pump care on a wartime basis. Applies to all makes. Sent free while supply lasts. Allis-Chalmers Mfg. Co.

21 Pump Data — 18-page booklet "Pump Fundamentals" with pump application data sheets containing both elementary and advanced technical data on selection, installation, operation and maintenance of all industrial pump types for general and specialized services. Goulds Pumps, Inc.

22 Centrifugal Pump — Bulletin 236 describes and illustrates the Type DBH, single stage, double suction, centrifugal pumps. The bulletin includes specifications, a sectional drawing, rating table and table of dimensions. Warren Steam Pump Co., Inc.

INSTRUMENTS AND CONTROLS

23 Voltage Regulators — 16-page spiral-bound book entitled "Undervoltage, the Unseen Hindrance to War Production" states that proper voltage is important to war production and that the use of regulators saves copper, man-hours, and cuts installation time. General Electric Co.

24 Recording Equipment — 16-page revised catalog describes improvements in Micromax CO_2 recording equipment. Also contains full-size reproductions of round and strip-chart records and illustrations of installations. Leeds & Northrup Co.

25 Control Data—Bulletin No. 8301, 56 pages, describes electric, pneumatic, as well as combined controls and defines various technical terms used in descriptions. Photographs illustrate 44 industrial controls and safeguards such as temperature controllers, float switches, combustion safeguards, etc. Brown Instrument Co.

26 Conservation Folders — Series of instruction pamphlets show how to make equipment last longer. Among the titles already issued are, "How To Make Your Thermometers Last Longer" and "How To Make Your Safety and Relief Valves Last Longer." Suggestions will be helpful even on competitive products. Manning, Maxwell & Moore, Inc.

27 Handy CO_2 Analyzer — Bulletin 338 describes simplified Firite "Orsat" analyzer. Held in hand while you make tests. A complete analysis in 40 seconds. Also tells about Fire Efficiency Finder—a calculator that converts CO_2 and stack temperature readings into heating efficiency percentages. Bacharach Industrial Instrument Co.

Indicate the literature you want on reverse side of this card. No postage is needed on it.

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28 **Hydraulic Control** — Helpful 4-page Bulletin EHC-78-C discusses Sperry "Exactor" hydraulic control, its applications, advantages and accessories. Photographs and diagrams are also included. Sperry Products, Inc.

29 **Flow Meters** — 16-page catalog describes and illustrates complete line of company's equipment, including meters for measuring flow, pressure, level and temperature of steam, water, gas, air and oil, CO_2 meters, pneumatic remote measurement and control systems; regulators, automatic combustion control. Republic Flow Meters Co.

30 **Rheostats**—Bulletin No. 1705 outlines Jagabi rheostats in four sizes and 76 ratings. Several types illustrated and prices applying given. James G. Biddle Co.

31 **Industrial Control Instruments** — Five new bulletins describe a complete line of industrial indicating, recording and control thermometers. Bulletin G23-S discusses operating principles of all types of thermometers; Bulletin G503-2 covers the company's recording control thermometer; Bulletin G603-2 covers the indicating control thermometer; Bulletin G303-2 describes and gives applications for the indicating thermometer; and Bulletin G403-2, covers the recording thermometer. Wheelco Instruments Co.

32 **Recording Instruments** — Catalog No. 76 JF, 24 pages, lists the bourdon spring, bellows and manometer instruments for indicating, recording and controlling pressures. Also contains information on gage, differential and absolute pressure and vacuums. Taylor Instrument Cos.

33 **Manometers** — Bulletin No. 200 presents Simplex manometers for measurement of water, steam, boiler feed, and industrial liquids in power and process industries. Includes specifications, capacities, and method of connection, and reference section of manometer data. Bulletin 250 gives detailed dimensional and specification data on Simplex rate of flow controller. Simplex Valve & Meter Co.

34 **Air Control** — Vertivent heater and ventilator, a combination forced air and blackout air control unit for industrial plants, is illustrated and described in Catalog 2942. Included is a cross-sectional drawing of the unit and tables of capacities and dimensions. Young Radiator Co.

MECHANICAL TRANSMISSION

35 **Belting Maintenance Handbook**—"How To Get The Most From Your Leather Belting" is the title of a helpful 24-page book recently issued. Includes practical tips on how to make belts endless on the job, alignment of shafting and pulleys, belt maintenance, etc. J. E. Rhoads & Sons.

36 **Wire Rope Manual**—Well illustrated 82-page book, "Know Your Ropes," provides a helpful handbook on the selection, application and usage of wire rope. Contains many diagrams for splicing and attaching; also ideas for conserving the strength and life of wire rope. A valuable reference book for engineers and maintenance men. Wickwire Spencer Steel Co.

37 **Handbook on V-Belts** — 16-page pocket-size handbook entitled, "Plain Facts on Wartime Care of Rubber V-Belts," applies to all makes of V-belts and explains ways V-belt construction affects its maintenance, what determines life expectancy of a set of V-belts and what to do about worn sheaves. Allis-Chalmers Mfg. Co., Texrope Div.

38 **Drive Control**—"A Challenge to Designers of Drive Control" is the title of a new 14-page booklet B-3132, which describes the Rototrol, a direct current drive control for wider speed range, accurate control of speed, torque and horsepower, and uniform acceleration and deceleration. Charts, diagrams and photographs show how the Rototrol regulates by transposing mechanical and electrical quantities. Typical applications are also illustrated and described. Westinghouse Elec. & Mfg. Co.

39 **Speed Changers**—20-page bulletin B6013A includes diagrams, operating data and selection tables of speed changer units in sizes handling from 1½ to 75 hp. Also contains numerous photographs illustrating modern speed-changing equipment. Allis-Chalmers Mfg. Co.

40 **Leather Belting Calculator**—Handy slide-rule calculator enables you to figure belt speeds, horsepower per inch, belt widths, for required loads. Based on A.L.B.A. tables. J. E. Rhoads & Sons.

PIPING, VALVES AND FITTINGS

41 **Welding Fittings**—Bulletin WF-41 gives complete and interesting information on welding fittings (ells, tees, flanges, nipples, return bends, etc.) that improve design and reduce cost of piping systems. New American Standard for butt welding fittings is also listed. Midwest Piping & Supply Co., Inc.

42 **Pipe Friction Chart**—Chart determines the pressure drop accompanying the flow of air or gas through pipes of known diameter and length. An auxiliary alignment chart simplifies the calculation for systems containing piping of various diameters. De Laval Steam Turbine Co.

43 **Valves**—56-page catalog No. 12 includes complete design, dimensional and metallurgical descriptions of cast-steel stop, check, and stop-check valves. Also describes Edward patented Impactor handwheels, throttlers, bypasses, etc. Edward Valve & Mfg. Co., Inc.

44 **Metal Hose Handbook** — Bulletin No. H-201 gives complete information about Eclipse seamless flexible metal hose, widely used for handling alcohol, grease, hot liquids, oil, steam and other non-solids, where high temperature and pressures prevail, and where flexing and vibration are encountered. A helpful book for engineers, designers and specification men. Eclipse Aviation (Metal Hose Department) Division of Bendix Aviation Corp.

45 **Valve Maintenance** — Helpful 6-page bulletin No. 5, "How to Repair Valves", explains and illustrates steps to take in repairing leaky gate and globe valves with hints on how to reclaim discarded valves. Crane Co.

46 **Coal Valves**—Beaumont coal valves, particularly suited for installation in chutes feeding to pulverizers or stokers, are described in new bulletin. Valve bodies and gates are of cast iron to prevent corrosion or warping. Beaumont Birch Co.

47 **Condenser Tube Data** — Design and operating engineers wanting latest information on the manufacture, material selection and installation of condenser tubes will find it in the service manual, "Scovill Condenser Tubes". Available on request. Scovill Manufacturing Co.

48 **Underground Piping** — Wrought Iron For Underground Services is the title of a 36-page bulletin which discusses the most important factors effecting soil corrosion of underground piping, weighs theory against test results and outlines installation histories of water wells and lines, oil and gas wells and lines, gasoline lines and tanks, and electrical cable conduit. Many photographs of underground piping installations under varied conditions. A. M. Byers Co.

49 **Expansion Joints**—14-page bulletin No. 35-15B gives details of construction, dimensions, specifications, etc., of the Adsco piston-ring type, model A expansion joints, made in sizes from 2-20 in. for all pressures up to 400 lb. American District Steam Co.

50 **Cast Steel Valves**—New 4-page catalog No. 15-B describes precision-machined and wedge-tight cast-steel valves in 150-, 300-, and 600-lb. sizes, with photographs, diagrams and tables of dimensions. R-S Products Corp.

(Continued on Page 148)

This card should be filled in completely in order to secure the literature you request. Please indicate only the bulletins you particularly desire.

POWER PLANT ENGINEERING

FEBRUARY, 1943

Please have the manufacturers send me without obligation the literature indicated by the following paragraph numbers:

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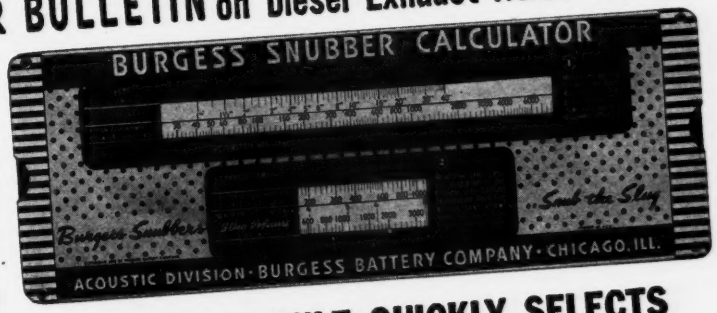
BURGESS SNUBBER BULLETIN on Diesel Exhaust Noise Control

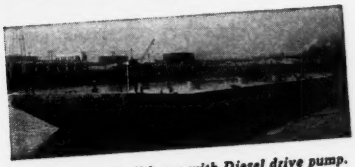


Diesel Pumps Allow Quick Handling of Oil Cargoes

Moving large amounts of oil is one of the jobs now being done by River Terminals Corporation, New Orleans, La. Over two dozen modern tank barges, each with a nine thousand barrel capacity, are doing the job.

Discharging these big barges is done quickly by a Diesel engine-driven pump mounted on each barge. The Buda engines are equipped with Burgess Spark Arrester-Snubbers to prevent noise and eliminate the fire hazard of flying sparks.

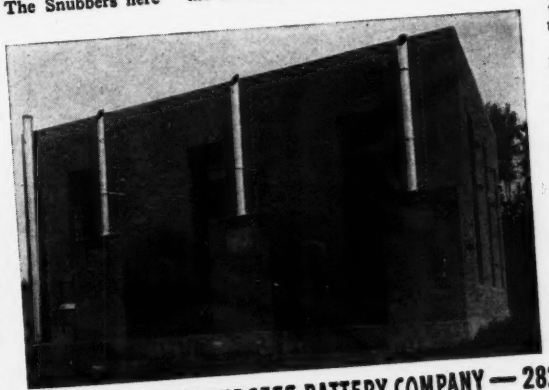
Snubber-equipped Buda engine drives discharge pump.



Big 9,000 barrel oil barge with Diesel drive pump.

Using Snubber Heat to Keep Plants Warm in Winter

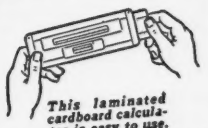
Many enterprising plant operators use the otherwise wasted heat from exhaust gases to warm their plants during the cold winter months. A very simple way to utilize this exhaust heat is shown in the picture at the right. The Snubbers here were enclosed, and openings made through the main wall into the engine room. Air passes into the Snubber compartment at the bottom and strikes the hot Snubber. This heated air is then carried back into the engine room through an opening near the top. An outside opening is provided for ventilating the Snubber during warm summer months.



Power plant at Plattsburg, New York.

NEW SLIDE RULE QUICKLY SELECTS PROPER SIZE SNUBBER

To supplement the regular recommendation sheets which are available for most engines, Burgess engineers have devised a new computing slide rule which quickly indicates the proper Snubber for use on any given engine application. While it is not intended to take the place of the specialized engineering which is often necessary with a difficult problem, it will enable designers and operating engineers to save time in making preliminary estimates. On most applications, the Snubber can be specified by means of this device.



This laminated cardboard calculator is easy to use.

Engine Data Needed

The rule incorporates four different scales, two on each side. By starting with scale one and working down to the last scale which makes two final computations, it is easy to select the correct Snubber for the job. The following must be known: number of cylinders, whether a two- or four-stroke cycle engine, bore, stroke, volumetric efficiency, exhaust temperature, and rpm. The first three scales compute the gas volume in cfm, and scale number four shows the size Snubber needed according to the average velocity of the gas. The illustration above shows scales number one and two.

The two main factors involved in the selection of a Snubber are: (1) the volume of exhaust gas passing through the Snubber and (2) its average velocity.

In order to see how this slide rule operates, let us take an example. On a given one cylinder, two-cycle engine with 4¼" bore, the stroke is 5". The first step is to set the stroke (5") beneath the bore (4¼"). When this is done, the operating piston displacement per cylinder in cubic inches can be read off the lower part of the same scale, above the operating volumetric efficiency. If we take volumetric efficiency as 130%, piston displacement is 92 cu. in.

Next, we set the 92 cu. in. displacement beneath the proper exhaust temperature on scale two. Suppose this is 700°F. The volume of the exhaust slug (the amount of gas ejected from each cylinder during each cycle) is then shown as 200 cu. in. At this point a red figure on this scale tells us that a 2½" Snubber is the minimum size which could be used. However, it is necessary to take into account the number of cylinders and the velocity of the exhaust gas in order to be sure this will be the right size. Therefore, we must carry our calculations further.

Finding Total Gas Volume

On scale number three, the slug volume of 200 cu. in. is moved below the number of cylinders, in this case "one." Supposing the rpm to be 1,200, we will then look above the mark on the slide rule which indicates 1,200 and find that the volume of exhaust gas is 140 cubic feet per minute.

On the number four scale, 140 is placed below an arrow marked "two-cycle." If this were a four-cycle engine, we would use the arrow marked "four-cycle."

Now we are able to see that with a 2½" Snubber, as indicated on scale two, the velocity of the exhaust gas is approximately 4,000 feet per minute. The table at the left of scale four gives the velocity range for this type and speed engine as 7,000-9,000 fpm, so that we are well within this limit. While a velocity of 7,000-9,000 fpm would seem to indicate the use of a 2" Snubber, our calculations of *slug volume* on scale two show that this would be too small. Therefore, the 2½" Snubber is the correct one.

If an average velocity less than 4,000 fpm is desired, a Snubber larger than 2½" must be used.

Slide rules of this type will be furnished free of charge to engineers and operators who request them.

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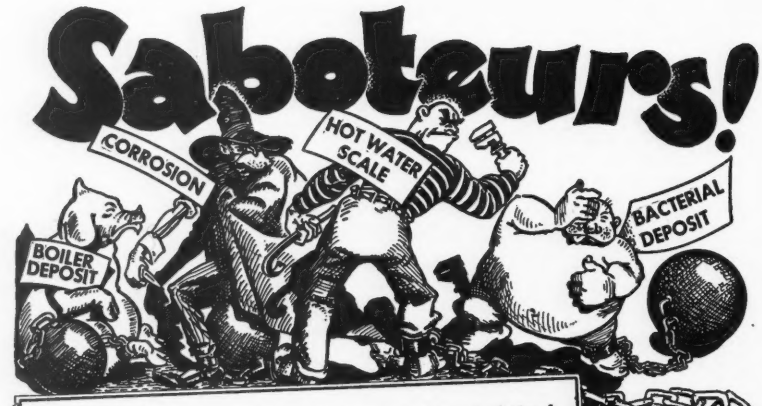
S—ORIGINATORS OF SNUBBING PRINCIPLE FOR QUIETING DIESEL EXHAUSTS—BURGESS—ORIGINAT
MPLETE SATISFACTION IN EXHAUST AND INTAKE QUIETING—SPECIFY BURGESS SNUBBERS—FOR COMPL



Saboteurs of war production have been caught and chained by us. Scale, corrosion, algae, and other deposits are cutting down the efficiency of your plant. Then, too, you are losing much of your operating force; or at least have it changed from month to month. So more than ever you need our help in controlling these insidious saboteurs of your plant.

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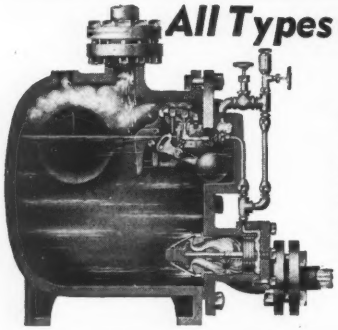

PISTON OPERATED

A compact trap with super capacity. Positive, instantaneous, non-wire-drawing discharge valve — entirely open or fully closed at all times. Stainless steel valves, seats and all working parts. For super-pressures and super-heat, specify Nicholson piston operated traps.

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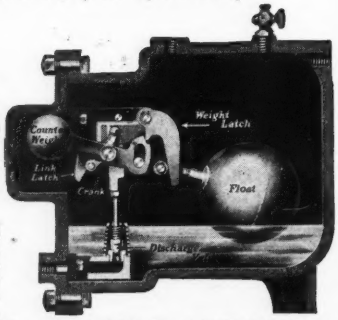
Positive automatic intermittent action. Large capacity. Pressures to 1500 lbs. at 1000 degree max. temp. Meets ALL requirements of modern high pressure power plants.



THERMOSTATIC models are non air-binding . . . freeze-proof . . . non dribbling . . . require no adjustments . . . never water-log. Large capacity. Four types. Sizes ¼" to 2". Pressures from vacuum to 300 lbs.

CATALOG No. 941 — W. H. NICHOLSON & CO., 160 OREGON ST., WILKES-BARRE, PA.

NICHOLSON Traps

THERMOSTATIC ▼ PISTON AND WEIGHT-OPERATED STEAM GASOLINE AND COMPRESSED AIR TRAPS

CONTROL VALVES ▼ FLOATS ▼ MANDRELS ▼ STEAM AND AIR SEPARATORS

51 **Steam Traps** — Inverted bucket steam traps are described in a well-illustrated, 8-p. catalog. The operating principle is discussed and various types for pressures from 1 to 15 lb., 10 to 125 lb., 10 to 250 lb., and up to 900 lb. and for superheat, are described in detail, with tables of capacities and dimension drawings. Sarco Co., Inc.

52 **Pipe-Joint Compound** — Pocket-size circular, 6 pages, discusses X-Pando, pipe-joint compound that expands slightly after setting. Also lists typical users. X-Pando Corp.

53 **Heat Exchanger Tubing** — Attractively illustrated bulletins show application advantages of Electrunite tubing for heat exchanger, condensers, boilers, etc. These electric resistance welded tubes are said to be uniform in wall thickness, which ends uneven thermal stresses, assures easy economical installation. Steel and Tubes Div. of Republic Steel Corp.

53-B **Valve Reseating Machines**— New Catalog 40—32 pages—offers complete explanation of construction and operation of valve reseating machines for either gate, globe or pump valves. Easily operated, reliable, efficient and durable, these machines save many valves from discard. The Leavitt Machine Co.

PRIME MOVERS

54 **Gas Engines** — Vertical 4-Cycle totally enclosed Type CCG gas engines are illustrated and described in Bulletin S-550-B21. Contains photographs of installations, cross-sectional drawings, tables of dimensions. Worthington Pump & Machinery Corp.

55 **Steam Turbines**—6-page Bulletin No. 1951 illustrates the special features of types GA & GB steam turbines with combined reduction gears. Also contains photographs of typical installations. Moore Steam Turbine Div.

56 **Diesels** — Specification sheets, 9, cover company's line of Diesel-generator sets, engines and power units in three sizes, 2, 4 and 6 cylinders. Also show photograph and dimensional diagram of each type described. Hill Diesel Engine Co.

WATER TREATMENT

57 **Chemical Proportioneer** — Bulletin No. 310 describes Graver chemical proportioneer, a new device providing accurate control of chemicals fed into the water-treating plant in proportion to the volume of water. Permits instant increase or reduction of chemical charge over wide range. Graver Tank & Mfg. Co., Inc.

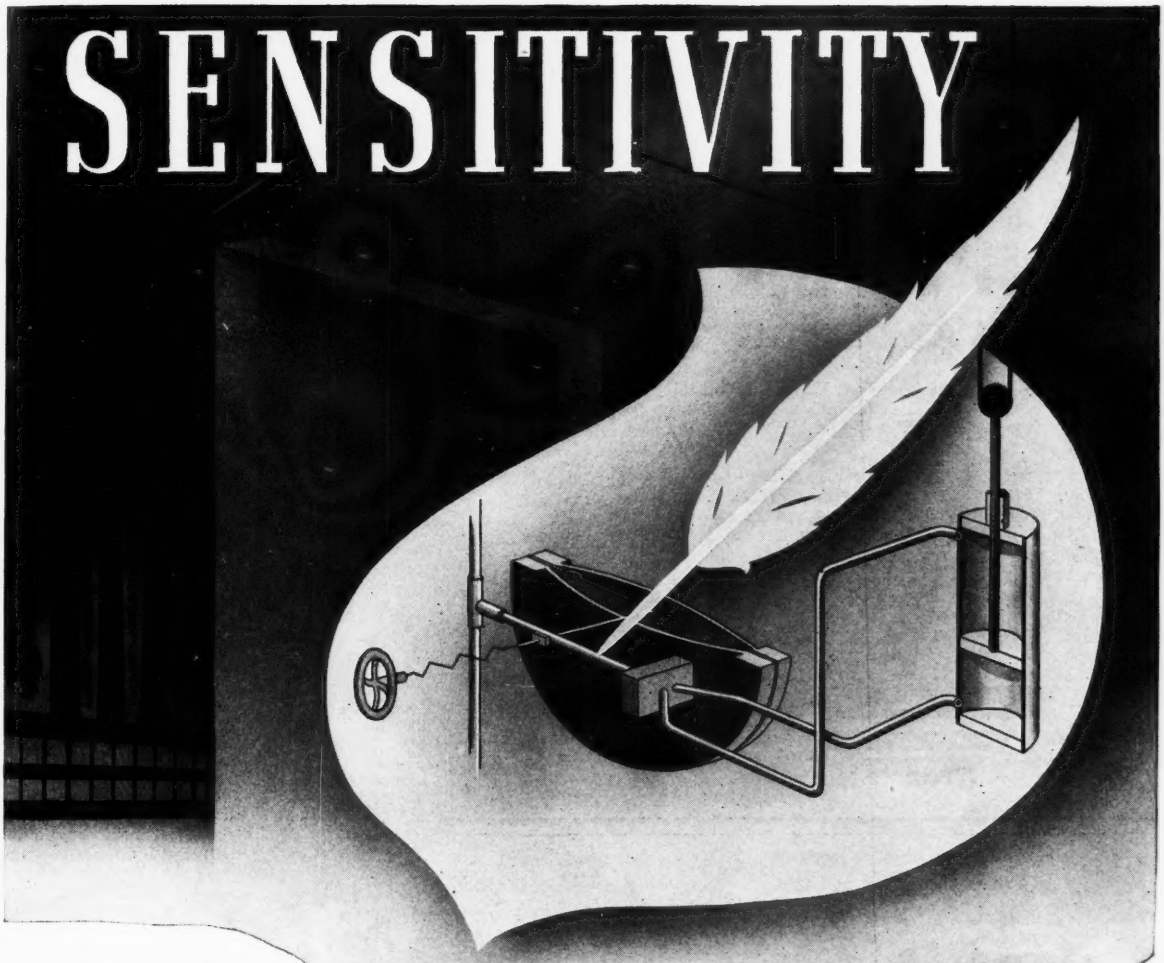
58 **Water Treatment**—12-page Bulletin No. 2420 describes proportioning and non-proportioning devices to feeders of phosphate, sodium sulphite, sodium sulphate, and other supplementary chemicals to boilers. Permutit Co.

59 **Chlorine Control** — Fifth edition of booklet entitled "Modern pH and Chlorine Control" discusses the meaning of pH control, methods, theory, applications and brief descriptions of company's line of equipment. W. A. Taylor & Co.

60 **Water Refining**—12-page Bulletin No. 101-B describes different types of equipment which answer problems of corrective chemical feeding for water refining. Bulletin serves as a guide for proper selection for individual applications. American Water Softener Co.

(Continued on Page 150)

SENSITIVITY



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*Specifically .001" W. C.

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Flexes quickly into any position

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This improved seamless, flexible tubing bends to any position, flexes quickly into any location. Also simplifies wartime redesign problems, eliminates the need of long pipe sections and many joints.

Let Eclipse engineers work with you in choosing the proper flexible hose for your plant requirements. Please specify purpose, conditions of installation, pressures and temperature, material to be conveyed.

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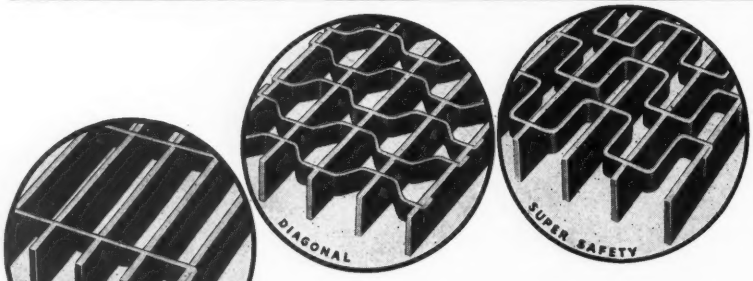

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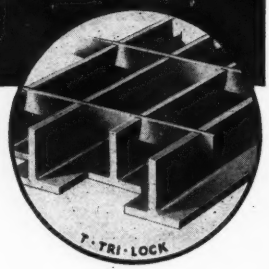


DRAVO CORPORATION
300 PENN AVENUE, PITTSBURGH, PA.
REPRESENTATIVES IN PRINCIPAL CITIES

61 Chemical Feeder — File No. 1100.26 contains general specifications for high- and low-pressure Adjust-o-feeders with a capacity range from zero to maximum g.p.m. against discharge pressures up to and including 2000 psi. Numerous photographs and diagrams shows design details. Proportioneers, Inc.

62 How We Read Water—A 48-page H.O.H. booklet of treatises on steam and return system corrosion—how to get accurate chemical proportioning—refrigerating brines—how we read water—interesting cases of control of corrosion, making pipes and boilers last for the duration—how we saved $25,000 in equipment in one plant . . . and many other vital facts. D. W. Haering & Co., Inc.,

63 Water Analysis — 20-page illustrated booklet presents various apparatus and chemicals used for industrial water analyses for plant control. Book features tests required for determining hardness, alkalinity, phosphate, sulfate, pH value, and others. Numerous comparators, photometers, turbidimeters, etc. are displayed. W. H. and L. D. Betz.

64 Water Softening — "Phosphoric Acid—A new Reagent for Use With Hot Process Water Softeners" is the title of an article describing the use of phosphoric acid in single or two-stage water softeners. The article gives a comparison of chemical costs as well as data showing the effectiveness of this treatment in a typical installation. Cochrane Corp.

64-B Algae Control—Algae control becomes of considerable interest at this time of the year in many parts of the country. The elimination of algae and slime in cooling systems is discussed in Nalco Bulletin No. 31 issued by the National Aluminate Corp.

MISCELLANEOUS

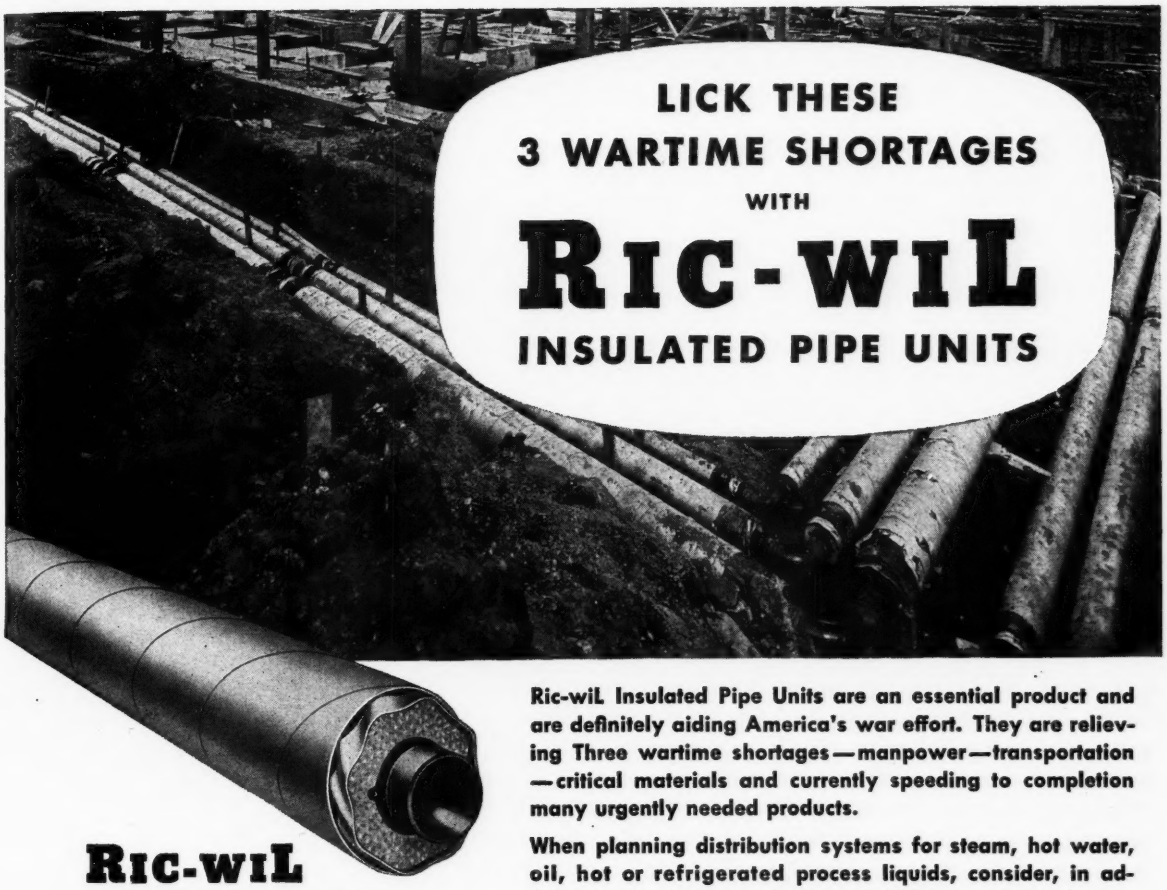
65 Power Check Chart — "National Power-Recovery Plan" is the title of a booklet describing a plan to stimulate the reduction of industrial power losses, whether you purchase your power or generate it. Containing a series of estimators, each relating to a certain phase of power service, you are enabled to report every possible power leak which can be corrected in various departments. L. H. Gilmer Co.

66 All Purpose Packings — Folder describes Allpax packing, in coil or loose form, for all stuffing boxes. Specifies styles to suit varying service conditions. The Allpax Co., Inc.

67 Lubrication Handbook — "Diesel Engine Lubrication" is the title of a 16-page booklet giving information on characteristics of Cities Service oils for Diesel engine use. Stresses importance of correct lubrication from both a maintenance and operating standpoint. Recommendation chart shows proper grades of principal brands of this company's Diesel engine oils, listed in accordance with engine builder's specification. Cities Service Oil Co.

68 Floor Repairs—A new tough floor patch or overlay "Instant-Use" for broken, rutted floors can be trucked over immediately following installation. Bonds to feather edge. Can be used over concrete or wood. Write for useful explanatory folder. Flexrock Co.

(Continued on Page 152)



LICK THESE 3 WARTIME SHORTAGES WITH RIC-WIL INSULATED PIPE UNITS

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Ric-wiL Insulated Pipe Units are an essential product and are definitely aiding America's war effort. They are relieving Three wartime shortages—manpower—transportation—critical materials and currently speeding to completion many urgently needed products.

When planning distribution systems for steam, hot water, oil, hot or refrigerated process liquids, consider, in addition to the features of fast installation, economical operation and low maintenance, these timely advantages—

MANPOWER

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CRITICAL MATERIALS

1 Ric-wiL Insulated Pipe Units are factory prefabricated (except at the joints). The installation is speedily accomplished, skilled mechanics and man hours required are reduced to an absolute minimum. Despite man-hours saved, the result is a permanent, low maintenance system—the best you can install.

2 Ric-wiL Insulated Pipe Units are designed to occupy absolute minimum space. They are shipped in gondola cars of which there is no shortage. Their uniform shape and lighter weight permit compact loading and require only smallest amount of critical transportation equipment.

3 Sound engineering holds critical materials in Ric-wiL Insulated Pipe Units to an absolute minimum—only 15% to 20% of total weight—used only where substitute materials cannot give the necessary mechanical strength required for a distribution system connecting your vital operating units.

When Makeshifts Won't Do – **RIC-WIL**

If you desire a copy of the Ric-wiL Engineering Data Book, simply write on your letterhead.

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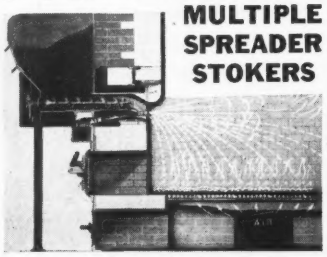
THE RIC-WIL COMPANY · CLEVELAND, OHIO
AGENTS IN PRINCIPAL CITIES

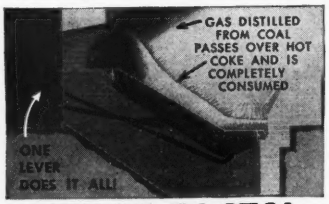
FYR-FEEDER MULTIPLE SPREADER STOKERS



BURN COAL LIKE OIL!

FUEL Shortage, Steam Shortage, Man-Power Shortage problems find a quick, efficient solution when you install the multiple FYR-FEEDER Spreader Stoker! Burns local coals—excellent results with cheapest grades—quick steam, less work, no clinkers. For all industrial applications. Quick Deliveries.

AMERICAN Hand Operated "Self-Cleaning" STOKERS



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2. **Quick Installation.** In a day's time.
3. **Modern Firing Method.** Employs fundamental "Cokal" firing principle. The *coking* method of firing which government engineers, smoke departments, combustion engineers recognize as highly successful for burning coal smokelessly and economically.
4. **Burns Any Coal.** Cheapest grades, all sizes, local and bituminous coal.
5. **Easy, Simple Operation.** No expert handling of shovel required. Pile coal at front. Advance fuel bed occasionally with lever; dump ashes as necessary.
6. **No Fans, No Motors — Natural Draft.**

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Established 1918 ENGINEERS 18 E. Erie St., Chicago

NO RUBBER BELTS in the...

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PATENT APPLIED FOR

For accurately weighing coal and similar materials from 1 to 60 tons per hour. Simplified design eliminates all rubber belts, pulleys and motors. Totally enclosed and dustproof. By-pass chute prevents flooding and will operate instantaneously.

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BULK MATERIAL HANDLING EQUIPMENT

69 **Sludge Solvent and Carbon Remover** — Literature describes a liquid compound for keeping oil systems operating at maximum efficiency by removing the hard carbon formed on burners and preheaters when fuel oil is burned, and by dissolving sludge in oil tanks. Maxfal Chemical Co.

70 **Insulation**—Helpful 16-page catalog discusses Baldwin-Hill insulations for industry and shows typical application photographs. Among the types of insulation discussed are rockwool blanket, pipe covering, insulating cement, koldboard and weatherseal. Baldwin-Hill Co.

71 **Free Repair Handbook** — A 40-page guide to the use of Smooth-On cements contains 170 diagrams and instructions for making lasting and economical repairs to plant equipment and machinery, pipe lines, fixtures, etc. Smooth-On Mfg. Co.

72 **Cooling Towers** — Well-illustrated Bulletin 804 explains essential features of Marley mechanical draft cooling towers. Contains map with summer wet bulb temperature data, other useful design and installation information on cooling systems. The Marley Co., Inc.

73 **Industrial Lubrication**—50-p. catalog contains a quick selection guide for use in determining the lubricating equipment best suited to any lubrication requirements. The equipment is charted in accordance with the kind of lubricants pumped, container capacity, operating power and pressure. The catalog covers both stationary and portable power guns, lubricant loaders and transfer pumps. Alemite Division, Stewart-Warner Corp.

74 **Tubular Dust Collector** — Dust takes a holiday when Thermix dust collectors are used. Catalogs No. 105-107 describe the three types designed to fit specific needs. Prat-Daniel Corp.

75 **Lubrication** — 16-page book entitled "Helping Industry Help America" contains case histories which show how engineering service in applying petroleum products in metal working, general lubrication, processing, mining, textile manufacturing and other operations is increasing American production. Sun Oil Co.

76 **Refractory Concrete** — 24-page book features characteristics of Lumnite, methods of making refractory concrete, heat-resistant concrete and refractory-insulating concrete. Book contains many photographs and tables. Atlas Lumnite Cement Co.

77 **Insulating Magnesia**—File No. 37b discusses physical properties and insulating characteristics of various heat-insulating materials, featuring Ehret's 85% Magnesia. Gives insulating and physical characteristics as well as dimensions and packaging information on various shapes, sizes and forms. Ehret Magnesia Mfg. Co.

78 **Metal Spray**—Well illustrated 16-page Bulletin No. 42A describes the metallizing process and equipment for its application. Tells briefly how essential industries are eliminating replacements and increasing service life of equipment now difficult to replace. Metallizing Engineering Co., Inc.

(Continued on Page 154)

WeldELLS

have everything

. . One of the things that speeds up the job and makes it better

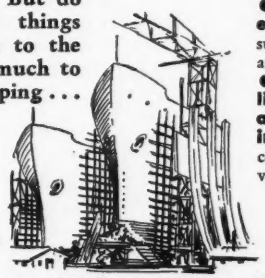
• Naturally any welder will work both faster and better when he works with fittings that are designed to help him do *his* part right. And you'll find welders pretty well agreed that WeldELLS offer more to the man on the job than any other.

A good example of this—a feature that is found only in WeldELLS—is illustrated above. These precision quarter-markings at each end of every WeldELL make it easy to establish center lines and follow planes. It's typical of the many features, listed opposite, that give the welder a real incentive to do a better job.

The features of WeldELLS that contribute to sound engineering design is still another story—told briefly in the listing, and eloquently by the preference of engineers. But do not forget that the things which mean so much to the welder, mean just as much to the man who designs piping . . . or pays for it.

Products vital to modern warfare

The list of Taylor Forge's contributions to the war effort only begins with WeldELLS. Every Taylor Forge product is playing a vital part. One of many examples is Forged Steel Welding Nozzles, essential to hundreds of transports and fighting ships.



No other fittings for pipe welding combine the features found in WeldELLS which, in addition to quarter-markings, include:

- **Seamless** — Greater strength and uniformity.
- **Tangents**—Keep weld away from zone of highest stress—simplify lining up.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum** — assures full strength and long life.
- **Machine tool beveled ends**—provide best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

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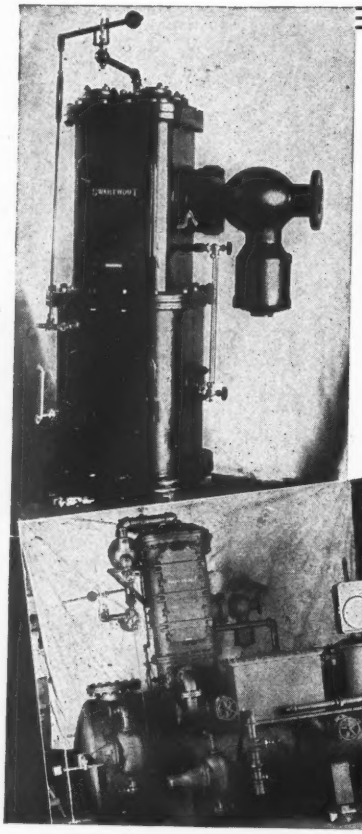

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FEED WATER HEATERS
Save Trouble and Money for Hundreds of Satisfied Users

YOU can have an adequate continuous supply of oxygen-free hot water for your boilers, assured by Swartwout's sound safe construction and guaranteed trouble-free results. Such performance cuts maintenance costs—keeps your plant running smoothly for vitally important production.

Swartwout Heaters are *engineered to fit your needs*—correct type, size and storage capacity. Your requirements gladly estimated. Write for Bulletins S-18-D and S-193.

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Power Plant Equipment

SAVES floor space

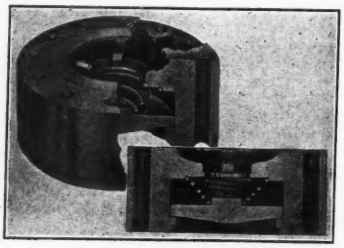
The De Laval-**IMO** *Rotary Displacement*
OIL PUMP

has neither valves nor gears and can be driven by a standard speed motor or turbine or coupled directly to some part of the machine served. The unit shown is a marine lube oil service pump. It delivers 600 g.p.m. and requires only 18 inches square floor space. Other models are available for bulkhead mounting or submerging in the oil tank. IMO pumps handle any grade of oil, in any volume and against any pressure.

Ask for Leaflet I-99

IMO PUMP DIVISION
of the De Laval Steam Turbine Company
Trenton, New Jersey

WILLIAMS-HAGER
Flanged Silent Check Valve



- Non-Wear Conical Spring
- Renewable Disc and Seat
- Works In Any Position
- Noiseless In Operation
- Protection Against Water Hammer

These improved side-guided check valves stay tight under every condition of service and pressure. Easily installed between flanges and readily removed for inspection. Sizes up to 20 in. and for pressures to 6,000 lb. They will handle all liquids, hot or cold—water, oil, gasoline, chemicals, etc. Get further details about this economical protection for pumps and service lines.

Ask for Catalog No. 142

THE WILLIAMS GAUGE CO.
3000 Pennsylvania Ave., Pittsburgh, Pa.

79 Heat Transfer—"Heat Transfer Through Metallic Walls" is the title of a recently printed bulletin explaining in detail how to calculate heat transfer. Covers conductance values of film, scale, and condensing vapor film. Includes tables on thermal conductivity of various metals, etc. The International Nickel Co., Inc.

80 Lubrication Chart—Newly issued bulletin describes Albany lubricants for industry; includes handy recommendation chart for lubricating compressors, conveyors, pumps, shafting, steam engines, turbines and other equipment. Albany Grease Co., Division of Adam Cook's Sons, Inc.

81 Handling Machinery—Modern materials handling machinery for the handling of coal, coke, ore and other bulk material is the subject of 24-p. Bulletin No. 121. Covers rope system bridges, man trolley bridges, towers, special rigs, grab buckets, car dumpers, car and barge hauls, rail clamps and cable railways. Many photographs of actual installations. Robins Conveying Belt Co.

82 Insulation Guide—Handy file-size folder is packed with useful information on asbestos, magnesia and other heat insulation for power and industrial plants. Specific recommendations for jobs from subzero to 2100 deg. F. Many charts and tables make this a valuable addition to every engineer's library. The Ruberoid Co.

83 Fire Extinguisher Cabinet—The Tam-Pruf cabinet for guarding fire extinguishers from sabotage or accident is described in new bulletin. Cabinet is padlocked to prevent tampering; no glass to break; extinguisher is visible at all times. Erie Supply and Equipment Co.

84 Low-Temperature Welding—In a 36-page catalog, a low temperature welding process is described in considerable detail, with many sketches of the welding procedures. Shows application to salvaging of tools and machinery; details on low temperature welding of cast-iron and steel, aluminum and aluminum alloys, brass, bronze, copper, nickel, monel, magnesium, etc. Eutectic Welding Alloys Co.

85 Wall Charts to Help You Identify Scrap Metals—"Identifying Metals by Spark Testing" is the title of an interesting wall chart that will help you identify metals for efficient classification of your scrap. Another useful chart "Simple Tests for Identifying Metals by Appearance, Chip Test, and Blowpipe Test" is also available. The Linde Air Products Co.

86 Lubricating Systems—Features of a centralized lubricating system said to provide economics through reduced consumption of power and lubricants, reduced labor of oiling, increased life of bearings and prolonged life of equipment, are described in an available bulletin. The Farval Corp.

87 Pipe Outlets—16-page Bulletin describes WeldOlets, ThredOlets and Socket-End WeldOlets, giving applications for which these three different types of fittings are suitable. All are designed for making the strongest possible right-angle welded branch pipe outlet in the least time and at the lowest cost. Included are stock sizes, dimensions, weights and list prices. Bonney Forge & Tool Works.

WARTIME OPERATION DEMANDS PRECISION LUBRICATION

Sure, breakdowns and delays are headaches to you these days. But, what's worse, they're caviar to Hitler!

All America is depending on you to go all-out for efficient, non-stop operation. And Cities Service can help you do it, these two ways:

1. Cities Service will send a lubrication engineer to study the needs and problems of your particular job. He will work out a lubrication plan to help keep your Diesels running at peak efficiency, to help you prevent breakdowns and costly repairs. In this work he will have at his disposal the Industrial Heat Prover (exclusive with Cities Service), an instrument that eliminates guesswork in analyzing Diesel engine operating problems.

2. Cities Service will supply you with *precision-perfect lubricants*. Cities Service Diesel Oils have been tested under the tough demands of actual day-to-day operation. And they have proved powerful allies in achieving steady, flawless, economical operation of Diesel machinery.

It costs you nothing to consult with a Cities Service engineer, and you are not obligated in any way. Simply call or write the office nearest you.

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NEW YORK · CHICAGO

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Have You Tried FRANCE Metal Packing?

The France Representatives listed below are packing experts. They are experienced in the solution of engine, pump and compressor packing problems that have to do with pressure, temperature, friction and lubrication. They are good men to know well. Tear out this list or at least the number nearest you. Keep it handy. Use it to your advantage.

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Request France Engineers to analyze your packing requirements.

THE FRANCE PACKING COMPANY
Tacony, Philadelphia, Penna.

Original **FRANCE METAL PACKING**

High Inertia Generators To Save Copper

HIGH INERTIA electric generators usually require large diameter rotors since inertia is proportional to the square of the radius. Large diameter rotors call for large amounts of copper. Confronted with the problem of providing generators of high flywheel effect for an aluminum plant, Westinghouse engineers solved the problem by using extra heavy rotor construction. First it was decided to reduce the rotor diameter, but this normally required a length of 17 in. By adopting the extra heavy rotor it was possible to cut the length to 13½ in. Thus the inertia was obtained with steel and the copper requirements were held to a minimum at the same time.

This design saved nearly a thousand pounds of copper on each of eighteen 2250-kw. generators. The machines are driven by Diesel engines and without high-inertia generation the pulsation of the reciprocating engines would be reflected in the voltage. This would have an adverse effect on the electrolytic cells where aluminum is deposited, according to Westinghouse experts.

Pioneer Automatic Hydro Station Still Operating After 25 Yr.

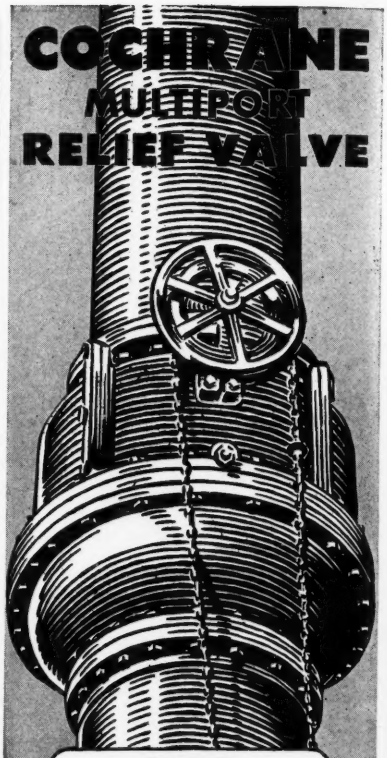
THE FIRST hydroelectric plant in the world to operate unattended with automatic control recently completed 25 yr. of service, during which no changes were required or made in the system. The only replacements have consisted of one relay, and new brushes on an exciter. It is the Cedar River plant of the Iowa Electric Light & Power Co.

The control system is an adaptation of the automatic railway rotary converter station developed by two General Electric engineers, since deceased. Among those who were interested in the development of the control system are J. M. Drabelle, consulting engineer for the utility company; Burdette S. Wright, then assistant electrical engineer, now vice-president-in-charge, Curtiss-Wright Corp., Buffalo, N. Y.; Lt. Col. John B. Madden, then draftsman at the Cedar Rapids power station, now distribution engineer of the Pacific Gas & Electric Co., San Francisco; and L. B. Bonnett, then control engineer for General Electric, now vice president of the Consolidated Edison Co. of New York.

The system enables one of the three machines in the station to be brought up to speed and voltage and put on the line in approximately 42 sec. Closing a starting button at the steam power station in Cedar Rapids sends an impulse over a pair of conductors to a master starting relay at the hydro station. If frequency is normal, this relay closes, energizing a circuit which rotates a drum controller.

The first set of contacts closed starts the motor-generator exciter set, which gets up to voltage and speed in about 4 sec. The drum controller then rotates again, closing a pair of contacts which energize the motor that opens the waterwheel gates. While the gates are opening, the controller is locked out until a speed device on

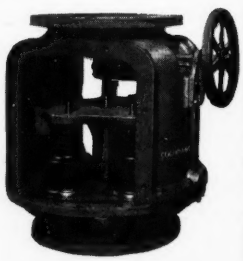
COCHRANE MULTIPORT RELIEF VALVE



The *SAFE* Valve

For BACK PRESSURE ATMOSPHERIC RELIEF AND FLOW OR CHECK VALVE SERVICE

Danger from sticking, jamming or freezing is eliminated by the multiplicity of valve disks instead of one large disk.



Chattering and pounding are also absent because the valve disks are light in weight with short travel and are further steadied by individual cushion chambers. Pressure is easily adjusted by varying the compression of the valve springs, which is done by shifting the pressure plate by means of a hand wheel, chain or motor.

Write for a copy of Publication 2870

COCHRANE CORP.
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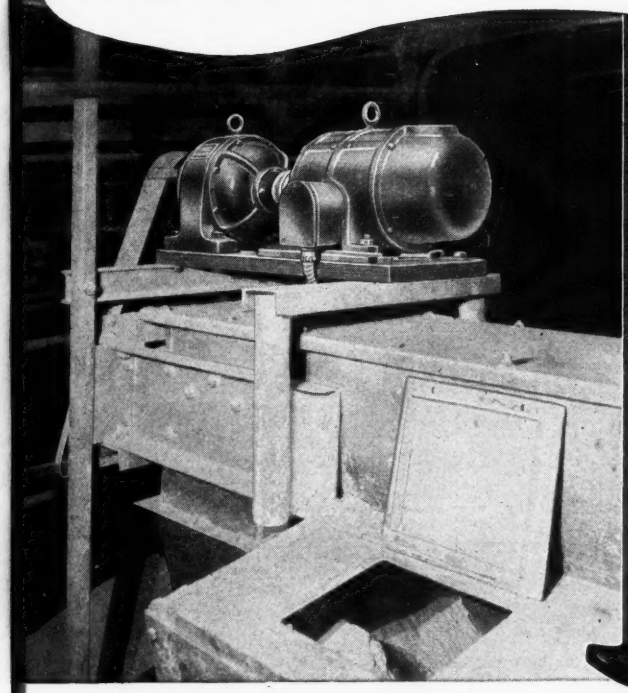
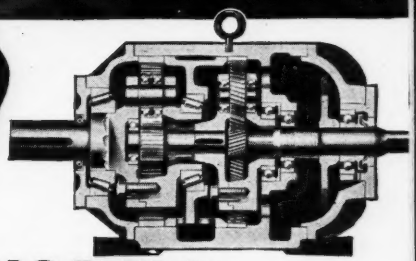
And you say "A PHILADELPHIA PLANETARY REDUCER WILL BEST FILL THE NEED FOR A STRAIGHT LINE DRIVE?"



For over ten years Philadelphia MotoReduceRs have been widely used where completely built-in motor and speed reducer units were indicated. However, for certain requirements, a speed reducer separate from the motor was desirable, and to meet this need *with a unit having definite superiorities over the old spur gear type reducer* we have taken the same construction features, parts and precision manufacture as employed in the MotoReduceR to build the Philadelphia Planetary Reducer. These reducers are available in single, compound and double reduction types to fit a variety of needs. Our catalog 100 gives more complete details and shows a number of methods for mounting the units. Send for a copy.



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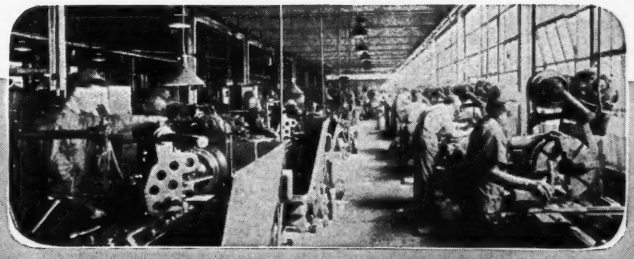
INDUSTRIAL GEARS
AND SPEED REDUCERS
LIMITORQUE VALVE CONTROLS

ERIE AVENUE & G STREET
PHILADELPHIA, PA.
New York, Pittsburgh, Chicago



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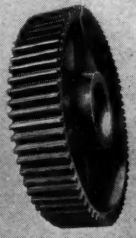
LIMITORQUE CONTROL
operates all types of valves, etc., safely, economically, from convenient stations.



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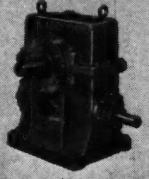
GEARS
All types and sizes of industrial gears. Can be supplied in all materials.



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right angle drives — vertical or horizontal. Wide range of ratios and horsepowers.

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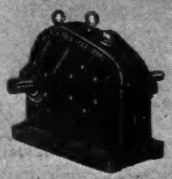
The economical self-contained drive, Horizontal or Vertical types — various ratios and horsepowers.



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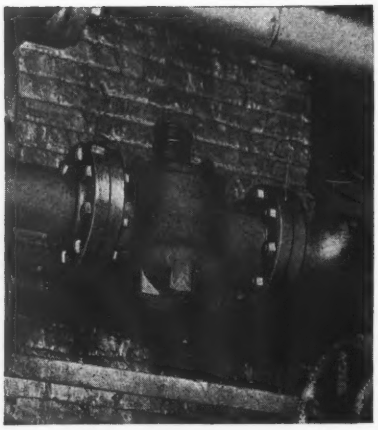
for heavy loads at high speed. Single, Double, Triple Reductions, various ratios and horsepowers.

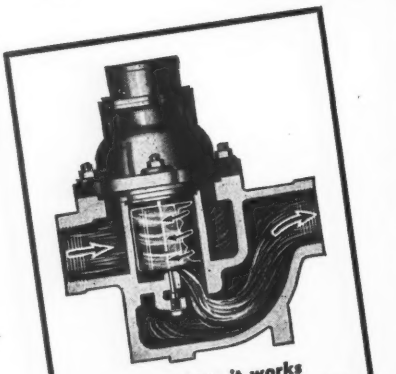


HENSZEY
BOILER FEED WATER
METERS
can measure it!

This war of production has brought to light some unusually difficult measuring problems. In many cases the HENSZEY Boiler Feed Water METER has been able to do the job where most ordinary meters failed.

Why? Because the Henszey Meter was developed to measure hot, dirty corrosive boiler blowdown. There are no close clearances to cause trouble. There are a minimum of moving parts. The Henszey Meter is equally accurate at high or low flow, high or low pressure, on reciprocating, duplex, triplex or centrifugal pumps. It can be calibrated to read in gallons, pounds or cubic feet at any specified temperature. Sizes 10 to 600 G.P.M., cold water steady flow rating. Connections: ¾" to 6". Special sizes to order.

HENSZEY COMPANY
Dept. C2 Watertown, Wis.



Here's how it works
Water enters the measuring chamber tangentially, spinning in the chamber as it passes through, forming a vortex. Each gallon that passes through this chamber makes the same number of revolutions of the water. A vane is placed in the rotating water to impart this rotation to the register.

HENSZEY

the generator shaft indicates 58 r.p.m. At that speed the drum controller begins rotating a third time, closing the main generator contactors and putting the generator on the bus through an iron-core reactor.

Immediately, a weak field is applied to the generator, the iron-core reactor is short-circuited, and full field is applied. A dual impulse from a contact-making ammeter and the drum controller opens the waterwheel gate to the setting of the limit switches.

The station's other two machines are started in the same manner except that there is no delay waiting for excitation voltage because one exciter set is already in operation.

During operation, the machines are protected by the usual overload and thermostatic devices. With the entire control system modeled along the lines of the railway block-signal systems, the opening of any circuits shuts down the machines.

To shut down one of the machines or the whole plant intentionally, the control buttons are turned to the open position at the steam power station. The hydro machines are dropped off the line, the exciter set is shut down, and the waterwheel gates are closed.

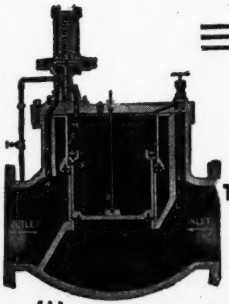
Reclaiming Oil from the Air

MASS-PRODUCTION, while solving the problem of providing war materials quickly, raises a serious problem according to Westinghouse engineers. High-speed machines must be flooded with cooling oil, sometimes at a rate of 5 g.p.m. Much of the oil pouring on a fast-spinning tool is whipped into a fine spray and the cutting-edge temperatures may even turn the oil to smoke. With row after row of these machines in war plants the air becomes filled with spray and smoke. The oil-laden air is drawn upwards toward the exhaust-air intake. Oil condenses on lighting fixtures, in bus ducts, on electrical insulation, walls, and other surfaces. The oil mist can be caught by the air-conditioning system, but the harm is done before the oil reaches the intake ducts.

The best solution seems to be to remove the vaporized oil at the individual machine. With a Precipitron built into the machine-tool itself, in a trial installation on one machine, Westinghouse experts filtered 4 to 5 gal. of cutting oil out of the air in one day. Visibility is improved, building maintenance is greatly reduced, and the life of power and light cables and controls is lengthened by the Precipitron installation. The air is more healthful and a worthwhile saving is realized on cutting oil, a critical material. In a large plant it would be possible for Precipitrons to salvage a tank-car of cutting oil from the air each day.

Obstacles Overcome in Constructing Gas Pipeline

THE WAY in which unusual obstacles were surmounted in the construction of the gas pipeline from Lirette, La., to Mobile, Ala., was described before the A.S.M.E. at their 63rd annual meeting by W. B. Poor, Supervising Engineer of the United Gas Pipe Line Co. of Shreveport, La. The purpose of the 200-mi. line was to supply the increas-



SINGLE ACTING SEMI-THROTTLING ALTITUDE VALVE
★

Installed in upstream line to tanks, standpipes or reservoirs, this valve sensitively maintains any desired water level to prevent overflow.

The valve is semi-throttling by gradually closing as water approaches the maximum water level to be controlled. The valve is self-contained without any waste of water from above the valve piston, and is especially desirable for service where a low head is to be maintained against a higher influent pressure.

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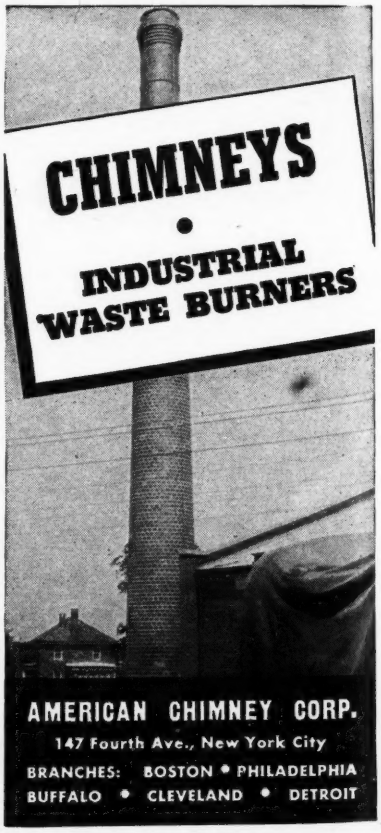
Fulton Building Pittsburgh, Pa.



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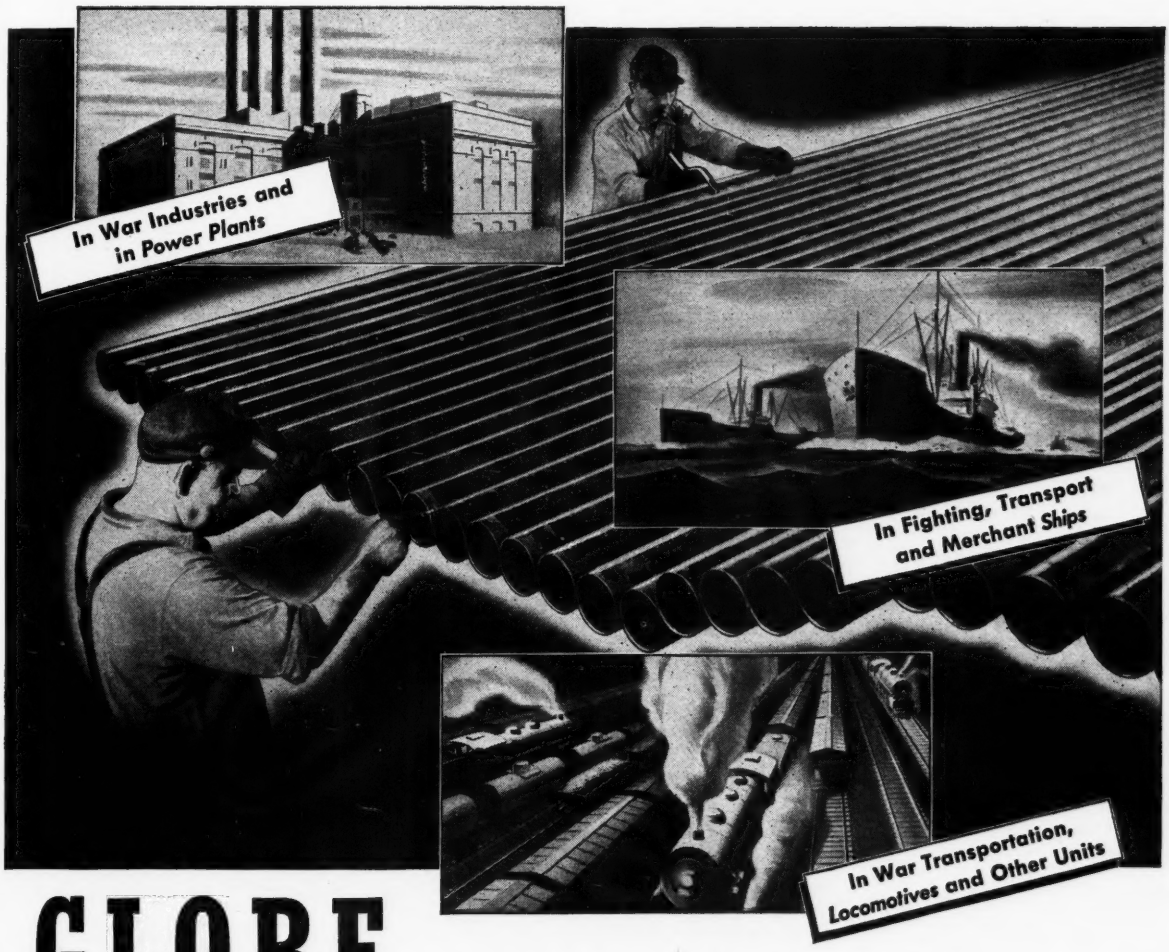
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Bleaches	Naphtha
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Catsup	Paraffine
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Cream corn	Rubber cement
Creosote	Salad dressing
Dog food	Shellac
Dyes	Silicate of soda
Enamels	Sizings
Fish oils	Soaps
Fuel oils	Solvents
Gasoline	Soups
Glucose	Starches
Glue	Syrups
Glycerine	Tan liquor
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POWER PUMPS, 5 to 700 GPM—up to 300 psi
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BLACKMER Rotary PUMPS
"BUCKET DESIGN"—SELF-ADJUSTING FOR WEAR

ing demands for natural gas fuel for the expanding war industries along the Gulf Coast as far as Pensacola, Fla.

The pipeline had to cross the Mississippi River, Lake Pontchartrain, which is 25.5 mi. wide at that point, and 65 other streams and canals. The major part of the land traversed by the line consists of reclaimed marshes and heavily timbered swamps, and special problems were presented by the corrosive nature of the soils, and the fact that the waters were infested with barnacles and marine borers.

The weather provided additional hazards, said Mr. Poor Construction commenced early in July, but the first pipe was not received until August 28, and September is a "hurricane month" in southern Louisiana. The original welding yard was flooded due to high tides caused by a tropical hurricane and had to be moved to a baseball park. During the 45 days of construction on the critical Lake Pontchartrain crossing, three storms caused a loss of 13 days' time. However, despite all unfavorable conditions, the entire project was completed and placed in service early in February, 1942.

Particular interest was aroused by Mr. Poor's description because of the pending construction of an oil pipeline from the producing fields of Texas to the East.

Grand Coulee Hits Record Output

POWER production at Grand Coulee Dam, vital to many Pacific Northwest war industries, hit a record high during October, 278,366,000 kw-hr. of energy being transmitted during the 31-day period, the Bureau of Reclamation reported recently.

The month's output brings the amount of power generated here during 1942 to nearly 1½ billion kw-hr., more than 12 times the 1941 delivery. The maximum demand during October, 380,000 kw., also constitutes a new project record.

Although but three of the eighteen 108,000 kw. generators ultimately to be installed in the plant are operating, the production at Grand Coulee is surpassed only by Boulder Dam and possibly by one or two other powerhouses. The monthly load is a staggering total, the electricity generated in October, for instance, being sufficient to produce a theoretical 420 four-motored bombers.

Much of this energy, as a matter of fact, is being used in the production of just such machines, aluminum reduction plants being Grand Coulee Dam's major customers. Large shipyards and plants manufacturing strategic chemicals and metal alloys for the war are also dependent on its big dynamos.

A year from now Grand Coulee will be generating more than twice as much energy as was metered in October. Three additional 108,000 kw. generators will have been seated alongside the present record-breaking trio, and two 75,000-kw. Shasta Dam units, now in the process of erection, will be turning. The latter two, temporarily transferred to Grand Coulee Dam to meet power demands, were scheduled to see duty at the end of 1942.

Heat Transmission Through Wet Building Walls

R. H. DEARBORN, dean of the School of Engineering at Oregon State College, Corvallis, and F. C. McIntosh, Pittsburgh, Pa., Chairman of the Committee on Research of the American Society of Heating and Ventilating Engineers, announce the consummation of a cooperative agreement to investigate the heat flow through wet building walls.

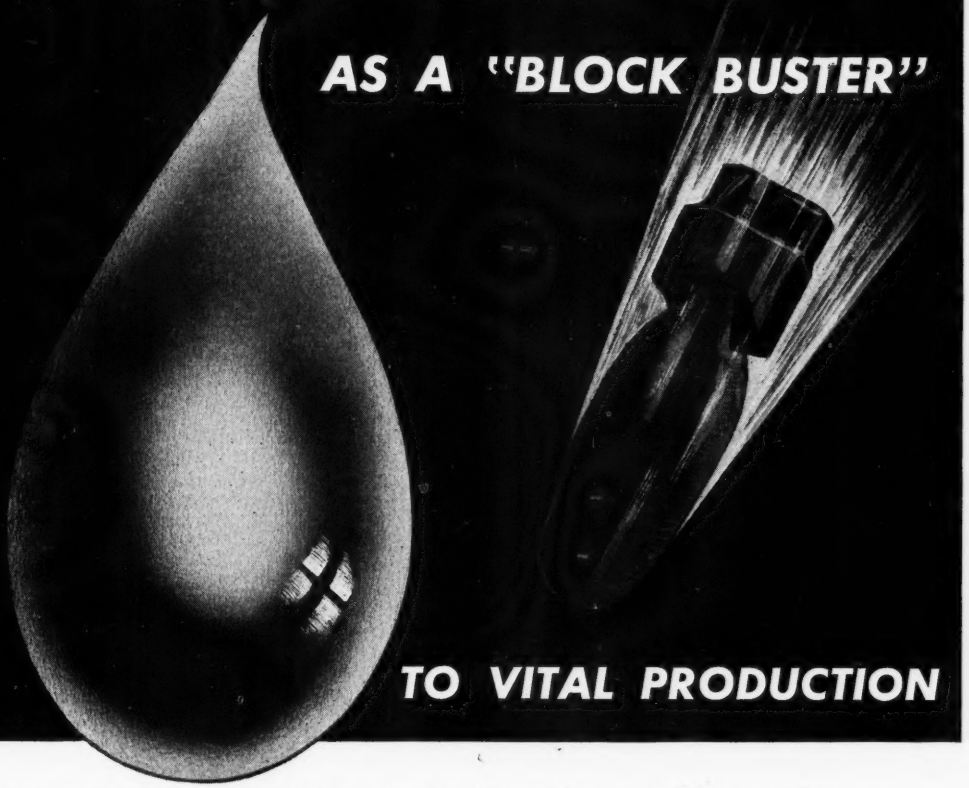
The research program will be carried on in the domestic heating laboratory of the College at Corvallis by means of a specially constructed apparatus in a study jointly planned by Prof. Earl C. Willey of the College and the research committee of the Oregon Chapter of the Society, of which Edwin W. Neubauer of Portland is chairman. Various types of building wall sections will be constructed and tested under conditions simulating heat loss during rainy weather.

Plans for Welded Pipe Line for Oil Transmission

THE Bayou Pipe Line System, Inc., care of the Shell Pipe Line Corp., Houston, Tex., recently organized by Shell and five other oil companies in the Texas area, has plans and surveys in progress for a new welded steel pipe line from the Houston-Texas City district to Baton Rouge, La., close to 300 mi., for oil transmission. The new line will

DAMAGING

AS A "BLOCK BUSTER"



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The damage may not be as spectacular, nor the destruction as sudden . . . but . . . the hundreds of tons of water used in your plant may be as crippling to vital production as the explosion of a 4000 pound bomb.

Water can play havoc with production schedules, waste precious fuel and ruin irreplaceable power plant equipment . . . unless it is conditioned against scale, corrosion, embrittlement, oil, etc.

Power plants . . . so essential to the war effort . . . are invited to make full use of Infilco's 49 years' experience in water conditioning. Call on our Chemical Engineering Staff for any problem involving boiler and evaporator feedwater treatment, condensate oil removal, steam purification or cooling water conditioning.

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Strong Type K Valves:
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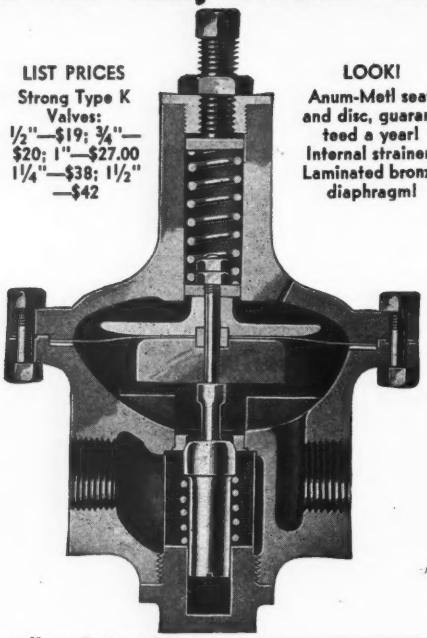
1¼"—$38; 1½"—$42

LOOK!
Anum-Metl seat and disc, guaranteed a year!
Internal strainer!
Laminated bronze diaphragm!



Name Your Reduced Pressure From 0 to 85 Pounds!

Here's the answer to accurate low-cost pressure reduction! Strong's Type "K" Reducing Valve, with its Anum-Metl seat, internal strainer, and simple, self-contained mechanism is ideal for reducing power steam to pressures you can use for heaters, cookers, driers, etc.

Adjusting spring holds valve open until reduced pressure reaches point desired. Outlet pressure then raises diaphragm against action of spring, closing valve, and completing cycle.

Write about your pressure reducing problems or for Catalog 154-PE-11.

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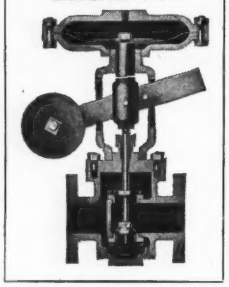

Strong Type "B"
For inlet pressure to 125 lbs., giving reduced pressure from 30 lbs. to 5 lbs. below atmosphere.

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STEAM SPECIALTIES

extend from Baytown to Port Neches, Tex., and thence to Baton Rouge, with a number of feeder pipe lines from refineries of the different companies in the coastal area. The Baytown-Port Neches section will be constructed of 8-in. pipe, and main line from that point to Baton Rouge, 10-in. Project will include a series of pumping stations at points along route for booster service, providing an estimated carrying capacity of 60,000 bbls. per day. Control stations and other operating facilities will be provided at different intervals. At the Baton Rouge terminus, connection will be made with the pipe line system of the Plantation Pipe Line Co., which extends from that point to Greensboro, N. C., and which recently has secured Federal permission to extend its lines to Richmond, Va. Construction of new Texas line is scheduled to begin at early date, utilizing available reconditioned steel pipe from other lines not essential at present time. It is estimated to cost approximately $7,000,000, which will be provided by the affiliated companies. These, in addition to Shell company noted, include Humble Pipe Line Co., Texas Pipe Line Co., Pure Oil Transportation Co., Pan-American Pipe Line Co., and Crown Central Pipe Line & Transportation Corp., all of Houston. Construction and operation of the new line will be under direction of the Shell company.

More Kilowatts for Public Service

WITH THE completion of a new 125,000-kw. turbine generator at the Marion Station of Public Service Electric & Gas Company, in Jersey City, the electric generating capacity of this station has been increased to 225,800 kw. and that of the entire Public Service system to 1,008,650 kw. Another new 125,000-kw. unit is under construction at the company's Burlington Station.

The low-pressure section (62,500-kw. capacity) of the new unit at Marion carried load for the first time a short while ago. The high-pressure section of the same unit has been in service since July, 1941. This section is also of 62,500-kw. capacity.

Since 1937 upwards of $90,000,000 has been allocated by Public Service for expansion and enlargement of electric facilities. The company's engineers are continuously studying load problems and making forecasts so that necessary electric power will be available for New Jersey industries. Plans for the new installation at Marion, the 125,000-kw. unit put in service at Burlington Station last year, the second 125,000 kw. unit now under construction at Burlington and the enlargement of electric generating facilities at the company's Essex Station at Newark were made long in advance of the demand upon New Jersey industries for increased production in connection with the war effort.

Today, New Jersey is in the forefront among the States in war production—with its great airplane plants, huge shipyards and many hundreds of other industries engaged in war work, the great majority of which depend upon Public Service for the three essential services—electricity, gas and transportation.

New Engineering Books

Heat Transfer by Natural and Forced Convection. By Allan P. Colburn. Size 6 by 9 in., 63 pp., paper cover. Published as Research Series No. 84 by the Engineering Experiment Station, Purdue University, Lafayette, Ind. Price 25 ct.

This bulletin presents the four lectures which were given by Professor Colburn at the University. The topics of the lectures were Introduction to Convection, Free Convection, Forced Convection, and Applications to the Design of Heat Exchangers.

Bibliography on Electrical Safety, 1930-1941. 8½ by 11 in.; 16-pp., paper cover. Published by the American Institute of Electrical Engineers, 33 West 39th St., New York, N. Y. Price 25 ct. to Institute members, 50 ct. to nonmembers, with discount of 20 per cent for quantities of 10 or more mailed at one time to one address.

This is the third bibliography under the same title published by the Institute. This publication is sponsored by the

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EVERY American-made shell stabbing through today's Axis landscape carries a promise . . . of plenty more coming . . . from an America now producing more than the enemy ever bargained for.

The thunder of our guns, daily more deafening to Berlin and Tokyo, voices the war-time industrial might of our factories and shipyards—turning mountains of raw materials into an endless and overwhelming flood of shells...ships...torpedoes...tanks...planes. In plants of all types throughout America, Todd Combustion Equipment is contributing to efficient, trouble-free power-production . . . maintaining unsurpassed standards in the combustion of liquid and gaseous fuels.

With over 50 thousand units now in active industrial and commercial service, Todd technical staffs . . . with parts and replacements instantly available in key cities . . . are cooperating with plant engineers responsible for uninterrupted firing on the vital power-production front.

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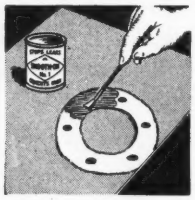
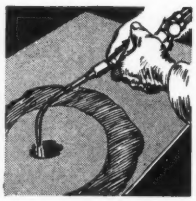
A SMOOTH-ON Speed-Up Tip...

When openings of various sizes are required for branch lines of brass piping or for connections of aluminum vessels, here is an aid to speedier and more accurate work recommended by experienced flame-cutting operators.

Just paint a thick consistency of Smooth-On No. 1 in a band about ¾-in. wide around the outer limits of the scribed opening. The Smooth-On acts as a refractory material to protect the metal which it covers, and helps to prevent melting of the metal beyond the desired limits.



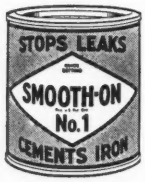
Smooth-On being applied as a thick paste outside of the outer edge of the scribed opening.



Flame-shaping the desired hole within the limits protected by Smooth-On.

This is but one of literally hundreds of ways in which the various Smooth-On Iron Cements can help you do better, quicker, more economical fabricating, maintenance, and repair jobs on plant equipment, pipe lines and structures.

Buy SMOOTH-ON in 7-oz., 1-lb. or 5-lb. containers or 25-lb., 100-lb. kegs at your supply house, or if necessary, from us. For your protection, insist on SMOOTH-ON, used by engineers for over 45 years.



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A.I.E.E. committee on safety and is designed to make available a fund of information on electrical safety which should be of special interest at this time when accident prevention is of national importance.

The items in this bibliography are divided into the following sections: Electrical accidents and their causes; accident prevention methods; safety codes and standards; effects of electric shock; and resuscitation. Information on safety published prior to 1930 may be located through bibliographies accompanying articles listed.

The Office of Price Administration has started quantity distribution of Manual No. 2, explaining how the service trades price regulation (Maximum Price Regulation No. 165 as Amended—Services) applies to the more than 600,000 service establishments throughout the country. It is intended as an aid to the many service trades affected in understanding the provisions of the service trades price regulation and in checking their ceiling prices under its terms. It explains how to arrive at maximum prices under the service trades price regulation, and various other requirements which service establishments must meet.

The 61 classes of service businesses regulated include among others the maintenance, rental and repair of many commodities, including automobiles, aircraft, boats, electrical appliances, furniture, and equipment for offices or stores; the services range from laundering and dry cleaning to window cleaning and stevedoring, commission selling, custom processing of many commodities and transportation brokerage.

Copies of Manual No. 2 are being distributed through all Regional and State OPA Offices and War Price and Rationing Boards, and various trade associations.

Fatigue of Metals. By D. Landau, engineer of the Nitralloy Corp., 230 Park Ave., New York City.

This is an 80-p. booklet devoted to conditions which limit the stress in metals by fatigue. This fatigue arises from repeated stresses of material at such values as will produce some permanent set, failure occurring after repeated applications and sooner with high stress or with reversal of stress from compression to tension.

The author has discussed at length the effect of shock, allowable stress range, endurance under repeated stress, relation of fatigue limit to tensile strength and effect of "stress raisers," such as machining marks, keyways, nicks, threads, sharp corners, corrosion pits, on the fatigue limit.

He then takes up the effects of Nitriding and the use of Nitralloy to offset the effect of fatigue stress. Other topics discussed are the increase of local stresses, effects of harmonic vibrations, temperature, speed of stress reversal, size of parts, prestressing of surfaces by rolling, compression and nitriding, strain relief by heat treatment.

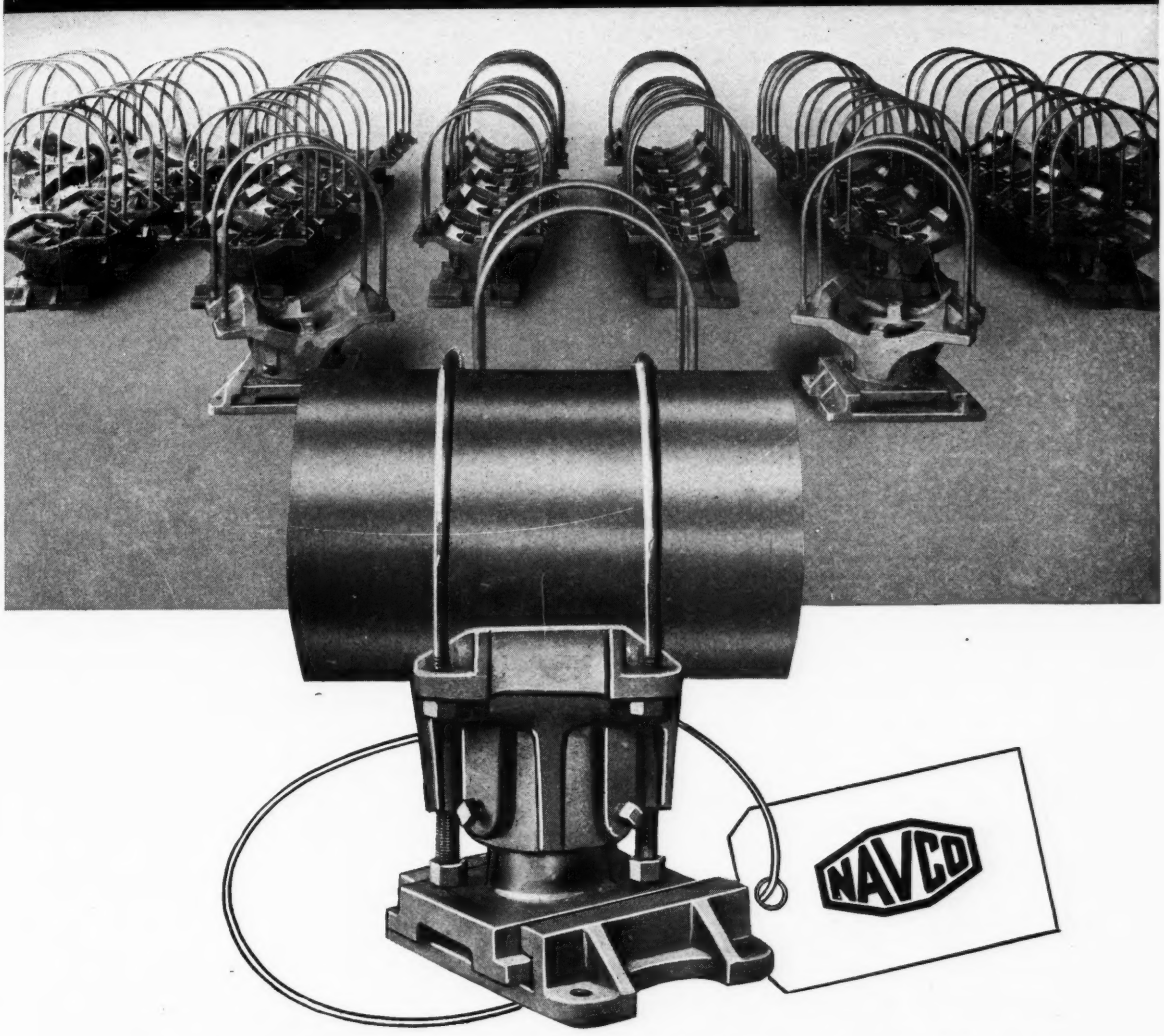
Empiric formulas and engineering designs based on safe fatigue limit are the concluding topic. An appendix describes machines for fatigue testing.

Wage and Salary Stabilization. Size 8½ by 10 in.; 59 p.; paper cover. Published by Research Institute of America, 292 Madison Ave., New York, N. Y. Price $2.00.

This book is another of the continuing series of analyses prepared by the Institute to assist business to make the best adjustment possible in the new business-government relationship. It covers the entire scope of the wage and salary stabilization act; tells what pay is covered; tells where to go with your questions concerning all types of employes, whether to the WLB, the Treasury or the Department of Agriculture among which the control over pay adjustments is divided. It lists all the regional, branch and field offices of the Wage and Hour Division which are operating as clearing houses on pay adjustments requiring WLB approval; the branch offices of the National War Labor Board through which adjustments on salaries over $5000 can be made; and the offices of the newly created salary stabilization unit of the Internal Revenue Bureau which will pass on requests for permission to make salary increases.

Other subjects covered are allowable pay increases, status of new employees, rules covering pension, bonus and insurance plans; tells what adjustments require approval; outlines in detail how to proceed on adjustments which do not require WLB or Treasury approval; gives recommended plans for formalizing pay policies; covers disputes on pay and union relations; analyzes the $25,000 salary ceiling and shows sample forms for employer's application for approval of salary adjustment.

NAVCO "UNIVERSAL" PIPE SUPPORTS



Navco Universal Support will take care of eight inches of expansion and can be made special to accommodate any amount of travel.

Vertical adjustment up to 2½ inches can be made.

Support may be turned to any angle of 360°.

Holds pipe down as well as up. Prevents pipe from getting out of alignment, which is usual in the Roller Type of support.

It permits control of expansion movement of pipe and insures the desired free action of Slip Expansion Joints so essential in tunnel and duct work.

Carrier is fixed to a predetermined point on the pipe, thereby eliminating possibility of destroying insulation. There is a recess in the saddle for insulation and the entire support can be insulated on the outside.

Navco Universal Pipe Supports are made of cast iron but can also be furnished in steel at increased prices. For installations exposed to the weather, bases can be furnished with brass liners or provided with forced lubrication.

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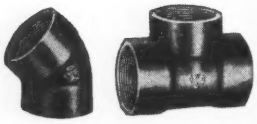
When you see it on Fittings



WHEN you use Watson-Stillman high-pressure, high-temperature Forged Steel Fittings for *all* of your needs, you can save yourself trouble *now* and save yourself money *in years to come.* The extra endurance of these Forged Steel "heavy weights" outweighs their cost. That's true economy, true conservation this year and any year.

The Watson-Stillman line includes screwed fittings and socket welding fittings, designed with more than ample metal sections and built with uniform wall thickness.

90 degree elbows, tees, 45 degree elbows, crosses, street elbows, laterals and crosses are forged solid from steel billets. Couplings, reducers, bushings, caps and plugs are machined from solid bars.

Bulletin A-3 lists all available Watson-Stillman fittings.

When you see it on Valves

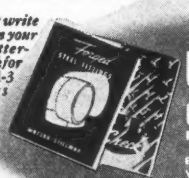
THE double diamond W-S trademark on a valve assures you of the same heavy-duty sturdiness that it stands for when you see it on a fitting.

Watson-Stillman makes bronze and forged steel globe, angle and check valves for high-pressure, high-temperature service, therefore giving you a margin of safety on lower pressures.

New valves have been added to make the line of greater use. Like Watson-Stillman fittings, these valves are available through mill supply distributors.

Bulletin A-4 describes and illustrates these valves.

FREE *Just write us on your business letterhead and ask for Bulletin A-3 on Fittings and Bulletin A-4 on Valves.*



WATSON-STILLMAN

Engineers and Manufacturers of Forged Steel Valves and Fittings, Hydraulic Machinery and Equipment—Hydraulic Presses, Pumps and Jacks

The Watson-Stillman Co., Roselle, N. J.

8183

Power Plant Construction News

Ala., Tuscaloosa—War Department, Washington, D. C., plans power house at new army general hospital in Tuscaloosa County (exact location withheld). Project will comprise large group of one and multi-story buildings, with mechanical laundry, shops, refrigerating plant, air-conditioning system and other facilities. Cost estimated over $4,000,000. Construction will be supervised by U. S. District Engineer Office, Mobile, Ala.

Calif., Los Angeles—Whiting-Mead Co., 2263 East Vernon Ave., Vernon, Los Angeles, manufacturer of plumbing equipment and supplies, plans installation of electric power equipment in new one-story addition, about 116 by 140 ft. Cost estimated over $65,000, with machinery. Work will be placed under way at once.

Conn., Manchester—Mutual Heating Co., Oak St., operating a central steam power station for heating service in downtown district, is planning conversion of power plant from oil to coal fuel, with installation of stokers, coal and ash-handling machinery, and auxiliary equipment. Proposed to carry out work soon.

Ill., La Grange—Electro-Motive Corp., La Grange, manufacturer of Diesel locomotives, a division of General Motors Corp., plans installation of electric power equipment in new one-story general maintenance building, about 23,000 sq. ft. of floor space, for which superstructure will begin soon. Cost reported over $85,000, with machinery.

Iowa, Britt—Central States Electric Co., Cedar Rapids, Ia., has plans under consideration for extensions in steam-electric power plant at Britt, with installation of additional equipment. No estimate of cost has been announced.

Kan., Wichita—Sisters of St. Joseph, care of Overend & Boucher, Brown Building, Wichita, architects, will build boiler house, about 36 by 72 ft., for central-heating service in connection with new two-story hospital on local site in vicinity of Lincoln and Hillside Sts. Entire project will cost close to $450,000. Proposed to begin work soon.

Md., Baltimore—Bartlett-Haywood division of Koppers Co., 200 Scott St., manufacturer of gas plant equipment, has approved plans for new two-story boiler house at works, about 30 by 50 ft., estimated to cost over $45,000, with boiler units and auxiliary equipment. Work is scheduled to begin at early date.

Mass., Quincy—Board of Education is planning conversion of boiler plants in a number of city schools, including Quincy High, Willard, Quincy and Massachusetts Field Schools, from oil to coal fuel, with installation of stokers, coal and ash-handling equipment, etc. No estimate of cost announced.

Mo., Kansas City—National Distillers Products Corp., Peoria, Ill., operating local whiskey distillery, plans installation of electric power equipment in proposed new plant at Kansas City for production of commercial alcohol for Government, comprising several large buildings for processing and other production service, tank house, boiler house and auxiliary structures. Cost reported about $1,800,000, with machinery. Financing will be provided by Defense Plant Corp., Washington, D. C.

N. J., Port Reading—Reading Co., Reading Terminal, Philadelphia, Pa., has completed plans for new boiler plant at Philadelphia & Reading Railroad yards, Port Reading, estimated to cost close to $45,000, with boilers and accessories. Proposed to proceed with work at early date. Company engineering department, first noted address, is in charge.

N. Y., Syracuse—Kilian Mfg. Corp., 1728 Burnet St., manufacturer of ball bearings and allied products, plans installation of electric power equipment in connection with expansion in plant for production for Government. Entire project will cost over $450,000, and will be financed by Defense Plant Corp., Washington, D. C. Proposed to carry out work at early date.

Ohio, Cincinnati—Water Department, City Hall, plans large pumping station, with motor-driven pumping units and auxiliary equipment, in connection with proposed expansion in water supply system and construction of new tunnel or supply line from source at place known as California. Entire project is estimated to cost over $7,000,000. Carl A. Eberling is waterworks superintendent.

Ohio, Dayton—U. S. District Engineer Office, Dayton, has plans maturing for addition to boiler plant for central-heating service at a Government project in Ohio (exact location not announced). No estimate of cost given. It is understood that bids will be asked soon.

Okla., Oklahoma City—Burke School of Aeronautics, Oklahoma City, has arranged with Government for construction and operation of new air force training school on site in Craig County (exact location withheld), consisting of hangars, shops, school buildings, warehouses and other structures. Electric power equipment will be installed, including power substation and distribution lines for light and power service. Entire project will cost over $1,500,000, and will be financed by Defense Plant Corp., Washington, D. C. Leon B. Senter, Philtower Building, Tulsa, Okla., is architect.

R. I., Providence—Rheems Shipbuilding Co., Field's Point, Providence, operating new local shipyard for production of vessels for Government, plans installation of electric power equipment in connection with rebuilding of one-story steel fabricating shop, 245 by 645 ft., recently destroyed by fire, with loss over $200,000, including machinery. Company is operated by Rheem Mfg. Co., Rockefeller Center, New York, N. Y., manufacturer of steel drums, etc.

S. D., Provo—Federal Public Housing Authority, Washington, D. C., and 201 North Wells St., Chicago, Ill., is considering boiler plant for central-heating service in connection with large housing development for army service at Provo, comprising over 200 family units. No official estimate of cost has been announced. Planned to begin work at early date.

Texas, Amarillo—City Council plans installation of centrifugal pumping machinery and auxiliary equipment in connection with extensions and improvements in municipal waterworks, including development of new water source. Entire project is estimated to cost close to $420,000. Freese & Nichols, Capps Building, Fort Worth, Texas, are consulting engineers.

Texas, Beaumont—Consolidated Frozen Food Lockers, Inc., Beaumont, plans early rebuilding of refrigerating plant, with locker system, recently destroyed by fire with loss reported close to $40,000, including equipment.

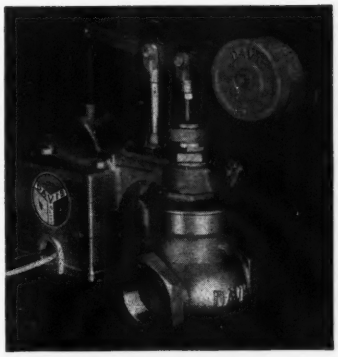
Texas, Fort Worth—Southern Ice Co., 2400 Cedar St., plans expansion and improvements in ice-manufacturing and refrigerating plant, including installation of additional equipment for increased capacity. Cost reported close to $40,000, with machinery.

Wash., Colfax—R. H. Sunderland, Colfax, plans installation of electric power equipment in proposed new local plant for the manufacture of starch, using surplus wheat as basic raw material. It will comprise a one and multi-story processing and production unit, and a number of auxiliary structures; entire project is estimated to cost about $200,000. Priority rating is being secured. Local Chamber of Commerce is interested in development.

Wash., Seattle—Sea-Bell Shipbuilding Co. plans series of new buildings at plant, including a boiler house, about 15 by 24 ft.; compressor station, 18 by 33 ft.; and power substation. Proposed to begin work soon. No estimate of cost announced. John S. Banchero is president.

Wis., Cudahy—Ladish Drop Forge Co., 5405 South Packard Ave., manufacturer of steel forgings, plans installation of electric power equipment in new one-story addition, about 150 by 200 ft., estimated to cost over $450,000. Work on superstructure will begin soon. Financing will be provided by Defense Plant Corp., Washington, D. C. Klug & Smith Co., 111 East Wisconsin Ave., Milwaukee, Wis., is engineer and contractor for building erection.

AUTOMATIC DISTANT CONTROL VALVE OPERATION FOR ANY JOB



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DAVIS SOLENOID VALVES

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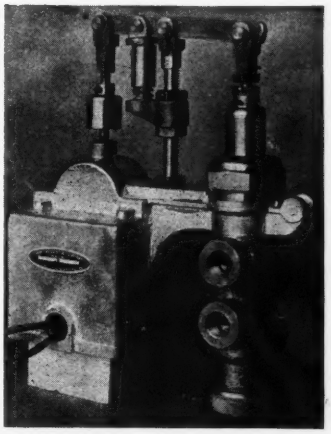
Left—No. 93—single seated, pilot operated general purpose valve.

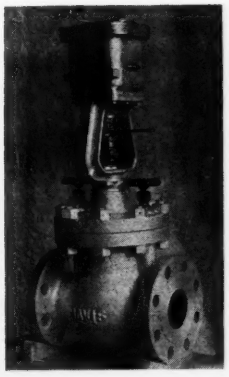
STANDARD Davis solenoid valves are available for steam, air, gas, water, oil and viscous liquids in a range of sizes from 1½" to 12" and for pressures up to 1500 lbs. They can be operated by any device which will make or break an electrical circuit. They may be either normally open or normally closed design. Solenoids can be housed in explosion proof boxes where required.

If you have a solenoid valve application, Davis engineers will be glad to give complete recommendations on the right valve for the job. Literature available on request.

DAVIS REGULATOR COMPANY
2508 S. Washtenaw Ave., Chicago, Illinois

Below—No. 380—a 3 or 4-way pilot valve widely used on air or liquid actuated power cylinders.





Above—No. 93-H with solenoid operated pilot valve and hydraulically actuated main valve built for use on a 400 lb. pressure water main.

DAVIS VALVES
DAVIS REGULATOR CO.

A Convenient Listing of Power Plant

WHERE TO BUY DIRECTORY

AIR CLEANERS
Burgess Battery Co.

AIR COMPRESSORS
De Laval Steam Turbine Co.
Fuller Company
Worthington Pump & Machy. Corp.

AIR PREHEATERS
Air Preheater Corp.
Babcock & Wilcox Company, The
Combustion Engrg. Co., Inc.
Foster Wheeler Corporation

AIR WASHERS
American Blower Corp.

ANTI-CORROSIVE COATINGS
Dampney Co. of Amer.
Haering & Co., Inc., D. W.

ANTI-FRICTION METAL
Magnolia Metal Co.

ARCHES, BOILER & COMBUSTION
Norton Company

BAFFLES, BOILER
Engineer Co., The

BEARING METAL
Magnolia Metal Co.

BELTS, V TYPE
Gilmer Co., L. H.

BELTING, RUBBER
Gilmer & Co., L. H.

BLOWERS, FAN AND FURNACE
American Coal Burner Co.
Coppus Engrg. Corp.
De Laval Steam Turbine Co.
Wing Mfg. Co., L. J.

BLOWERS, TURBINE
Elliott Company
Terry Steam Turbine Co., The
Wing Mfg. Co., L. J.

BOILER BLOW-DOWN SYSTEMS
Cochrane Corporation
Elgin Softener Corp.
Henszey Company
Infilco Incorporated
National Aluminate Corp.
Permutit Co., The

BOILER COMPOUNDS
American Water Softener Co., The
Buromin Co., The
Dearborn Chemical Company
Dowell Incorporated
Electric Chemical Co.
Haering & Co., Inc., D. W.
Permutit Co., The
Water Treatment Co. of America

BOILER FEED WATER PURIFYING APPARATUS
Cochrane Corp.
Elgin Softener Corp.
Graver Tank & Mfg. Co., Inc.
Infilco Incorporated
Permutit Co., The

BOILER SETTINGS
Carborundum Co., The
Engineer Co., The
Norton Company

BOILER & TURBINE COATINGS
Dampney Co. of Amer.

BOILER TUBES
Babcock & Wilcox Tube Co.
Electroweld Steel Corp.

BOILER WATER TREATMENT
American Water Softener Co., The
Betz, W. H. & L. D.
Cochrane Corp.
Dearborn Chemical Company
Dowell Incorporated
Electric Chemical Co.
Elgin Softener Corp.
Graver Tank & Mfg. Co., Inc.
Hall Laboratories, Inc.
Haering & Co., Inc., D. W.
Infilco Incorporated
National Aluminate Corp.
Permutit Co., The
% Proportioneers %, Inc.
Water Treatment Co. of America

BOILERS, POWER AND HEATING
Babcock & Wilcox Company, The
Combustion Engrg. Co., Inc.
Foster Wheeler Corporation
Murray Iron Works Co.
Springfield Boiler Company
Vogt Machine Co., Inc., Henry
Wickes Boiler Co., The

BREAKERS COAL
American Pulverizer Co.
Pennsylvania Crusher Co.

BRONZE BAR METAL
Magnolia Metal Co.

BUCKET ELEVATORS
Bartlett & Snow Co., The C. O.

BURNERS, COAL, PULVERIZED
Babcock & Wilcox Co., The

BURNERS, COMBINATION, OIL & GAS, OIL & COAL, GAS & COAL
Babcock & Wilcox Co., The

BURNERS, GAS
Engineer Co., The
Todd Combustion Equipment, Inc.

BURNERS, OIL
Babcock & Wilcox Co., The
Engineer Co., The
Todd Combustion Equipment, Inc.

BURNERS, WIDE RANGE OIL
Babcock & Wilcox Co., The

CEMENT, IRON
Smooth-On Mfg. Company
X-pando Corp.

CEMENT, REFRACTORY, ACID PROOF, FURNACE AND HIGH TEMPERATURE
Atlas Lumnite Cement Co., The
Babcock & Wilcox Company, The
Baldwin-Hill Co.
Carborundum Co., Inc.
Ehret Magnesia Mfg. Co.
Norton Company

CHAIN WHEELS
Babbitt Steam Specialty Co.

CHEMICALS, WATER TREATING
American Water Softener Co., The
Betz, W. H. & L. D.
Buromin Company, The
Dearborn Chemical Company
Dowell Incorporated
Electric Chemical Co.
Elgin Softener Corp.
Haering & Co., Inc., D. W.
National Aluminate Corp.
Permutit Co., The
% Proportioneers %, Inc.
Water Treatment Co. of America

CHIMNEYS
American Chimney Corp.

CLEANING COMPOUNDS
Calgon, Inc.
Dearborn Chemical Company

COAL, ASH HANDLING AND STORAGE EQUIPMENT
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Fuller Company
Sauerman Bros., Inc.

HOW TO DO A BETTER JOB OF *Laundering* WATER!

● The Ecco process of laundering water removes additional impurities and organic matter, thus providing increased output and a better finished water in all types of external treating plants.

The Ecco process..affords better coagulation..provides increased output..a better finished water..at a savings.

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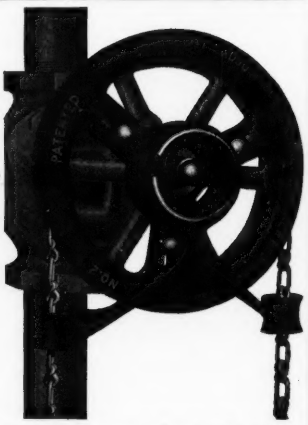
For All "HIGH-UP" VALVES



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Williams Valve Co., The D. T.
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Hagan Corporation
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American Blower Corp.
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COUPLINGS, UNION
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EVAPORATORS
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EXHAUST HEADS
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EXHAUSTERS FOR VENTILATING AND DRYING
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FANS, EXHAUST, VENTILATING AND DRYING
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Coppus Engrg. Corp.
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FEEDERS, CHEMICAL
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Manzel Bros. Co.
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%Proportioneers%, Inc.
FEEDERS, PULVERIZED COAL
Babcock & Wilcox Co., The
Fuller Company
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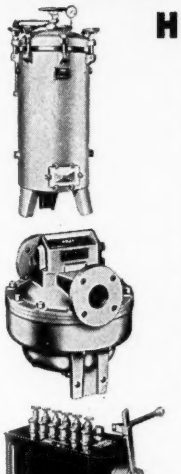

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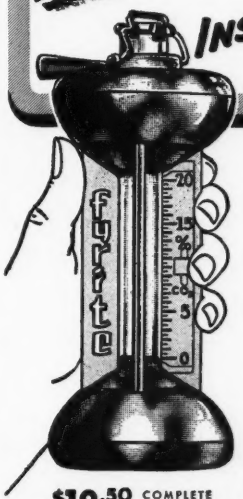

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SEND BUL. 338 on *FYRITE "ORSAT"*

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A Convenient Listing of Power Plant

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Betz, W. H. & L. D.
Buromin Company, The
Cochrane Corp.
Dearborn Chemical Company
Dowell Incorporated
Electric Chemical Co.
Elgin Softener Corp.
Hall Laboratories, Inc.
Haering & Co., Inc., D. W.
Infilco Incorporated
National Aluminate Corporation
Permutit Co., The
% Proportioneers %, Inc.
Taylor & Co., W. A.
Water Treatment Co. of America

FILTERS, OIL
Bowser & Co., Inc., S. F.
Nugent & Co., Inc., Wm. W.

FILTERS, OIL REMOVING
Elgin Softener Corp.
Infilco Incorporated
Permutit Co., The

FILTERS, WATER
Cochrane Corp.
Elgin Softener Corp.
Infilco Incorporated
Permutit Co., The

FIRE BRICK AND CEMENT
Babcock & Wilcox Company, The
Carborundum Co., The
Norton Company

FIRE HYDRANTS
Kennedy Valve Mfg. Company

FITTINGS, FLANGE AND PIPE
Crane Co.
Dart Mfg. Co., E. M.
Kennedy Valve Mfg. Company
Midwest Piping & Supply Co.
National Valve & Mfg. Co.
Taylor Forge & Pipe Wks.
Tube Turns, Incorporated
Vogt Machine Co., Inc., Henry
Watson-Stillman Co., The

FITTINGS, FORGED STEEL
Cochrane Corp.
Watson-Stillman Co., The

FITTINGS, MALLEABLE
Flori Pipe Co., The

FITTINGS, WELDING
Midwest Piping & Supply Co.
Taylor Forge & Pipe Wks.
Tube Turns, Incorporated
Vogt Machine Co., Inc., Henry
Watson-Stillman Co., The

FLAT GAUGES
Ernst Water Column & Gage Co.

FLOATS
Ernst Water Column & Gage Co.
Nicholson & Co., W. H.
Reliance Gauge Column Co.

FLOORING, OPEN STEEL
Dravo Corporation

FLOOR REPAIRS AND RESURFACING
Flexrock Co.

FLOW METERS
American Dist. Steam Co.
Bacharach Ind. Inst. Co.
Bailey Meter Company
Brown Inst. Co., The
Builders-Providence, Inc.
Cochrane Corporation
Leeds & Northrup Co.
Republic Flow Meters Co.

FLUE GAS ANALYSIS INSTRUMENTS
Bacharach Ind. Inst. Co.
Leeds & Northrup Co.
Permutit Co., The

FURNACE FIRE OBSERVERS
Springfield Boiler Company

FURNACE LINING BRICKS
Babcock & Wilcox Company, The
Norton Company

FUSES
General Electric Co.

GASKET CUTTERS
Allpax Co., Inc., The

GASKETS
Chesterton Co., A. W.
Ehret Magnesia Mfg. Co.
Garlock Packing Company
Raybestos-Manhattan, Inc.
Smooth-On Mfg. Co.

GAUGE COCKS
Condenser Service & Engrg. Co., Inc.
Ernst Water Column & Gage Co.
Huyette Co., Inc., The Paul B.
Reliance Gauge Column Co.
Williams Gauge Co., The

GAUGE GLASS PROTECTORS
Ernst Water Column & Gage Co.
Huyette Co., Inc., The Paul B.

GAUGE GLASSES
Chesterton Co., A. W.
Corning Glass Works
Ernst Water Column & Gage Co.
Huyette Co., Inc., The Paul B.

GAUGE GLASS GASKETS, HIGH TEMPERATURE
Chesterton Co., A. W.
Ernst Water Column & Gage Co.
Huyette Co., Inc., The Paul B.

GAUGES, DRAFT, LIQUID LEVEL
Bailey Meter Company
Brown Instrument Co., The
Hays Corporation, The
Leeds & Northrup Co.
Liquidometer Corp.
Republic Flow Meters Co.
Taylor Inst. Cos.

GAUGES, PRESSURE AND RECORDING
Bacharach Ind. Inst. Co.

GAUGES, TANK
Liquidometer Corp.

GAUGES, WATER
Ernst Water Column & Gage Co.
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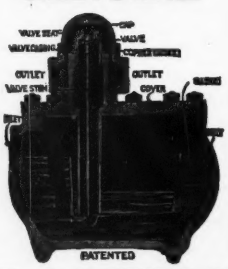

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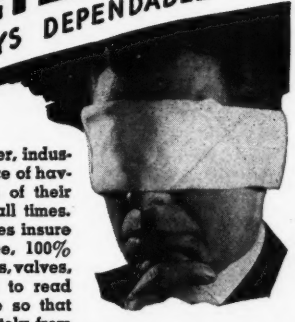

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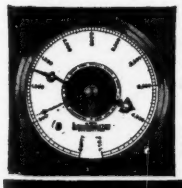

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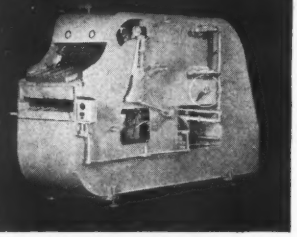

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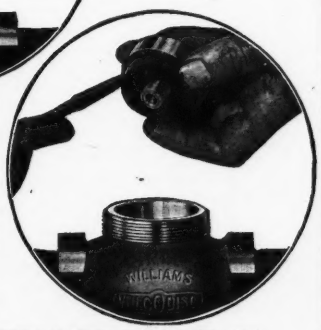

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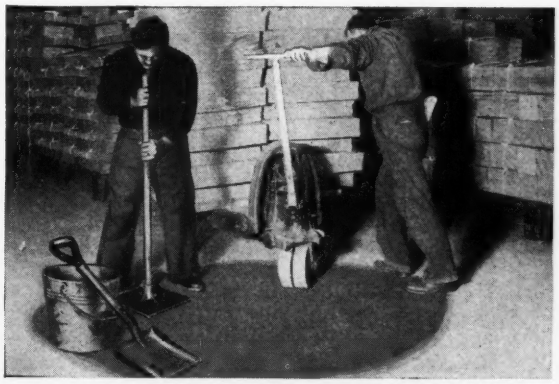

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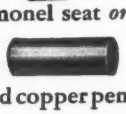

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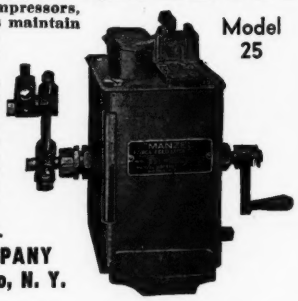

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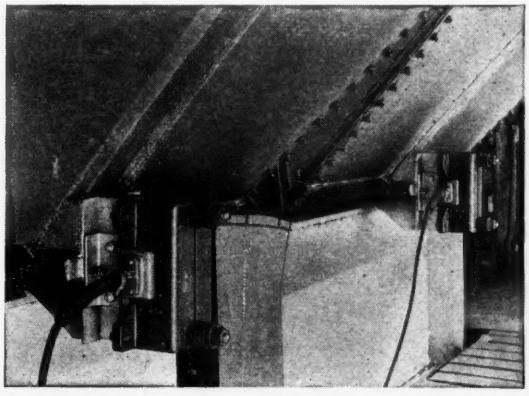

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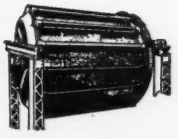

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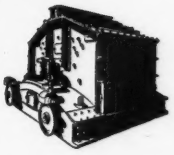

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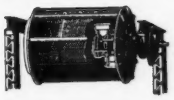

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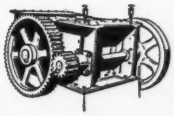

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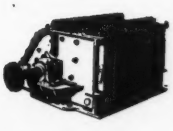

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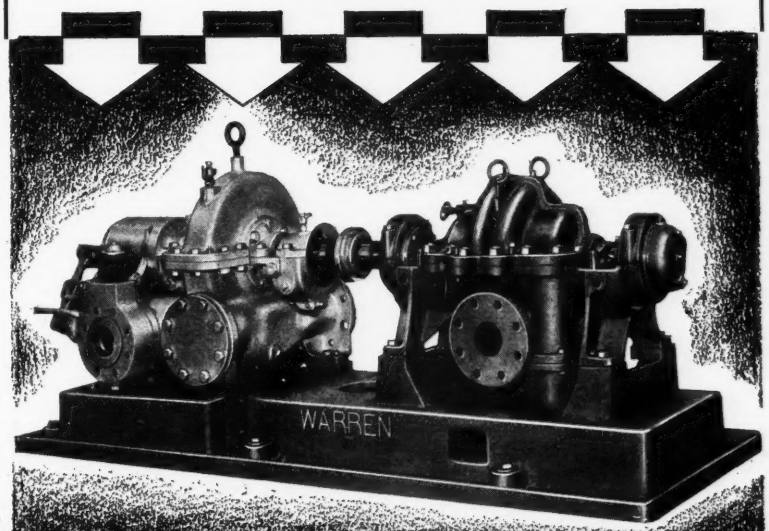

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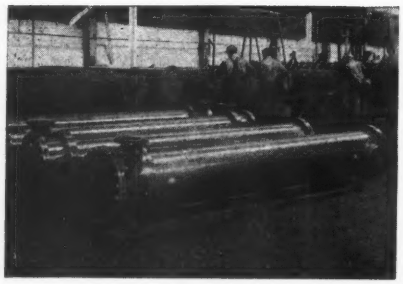

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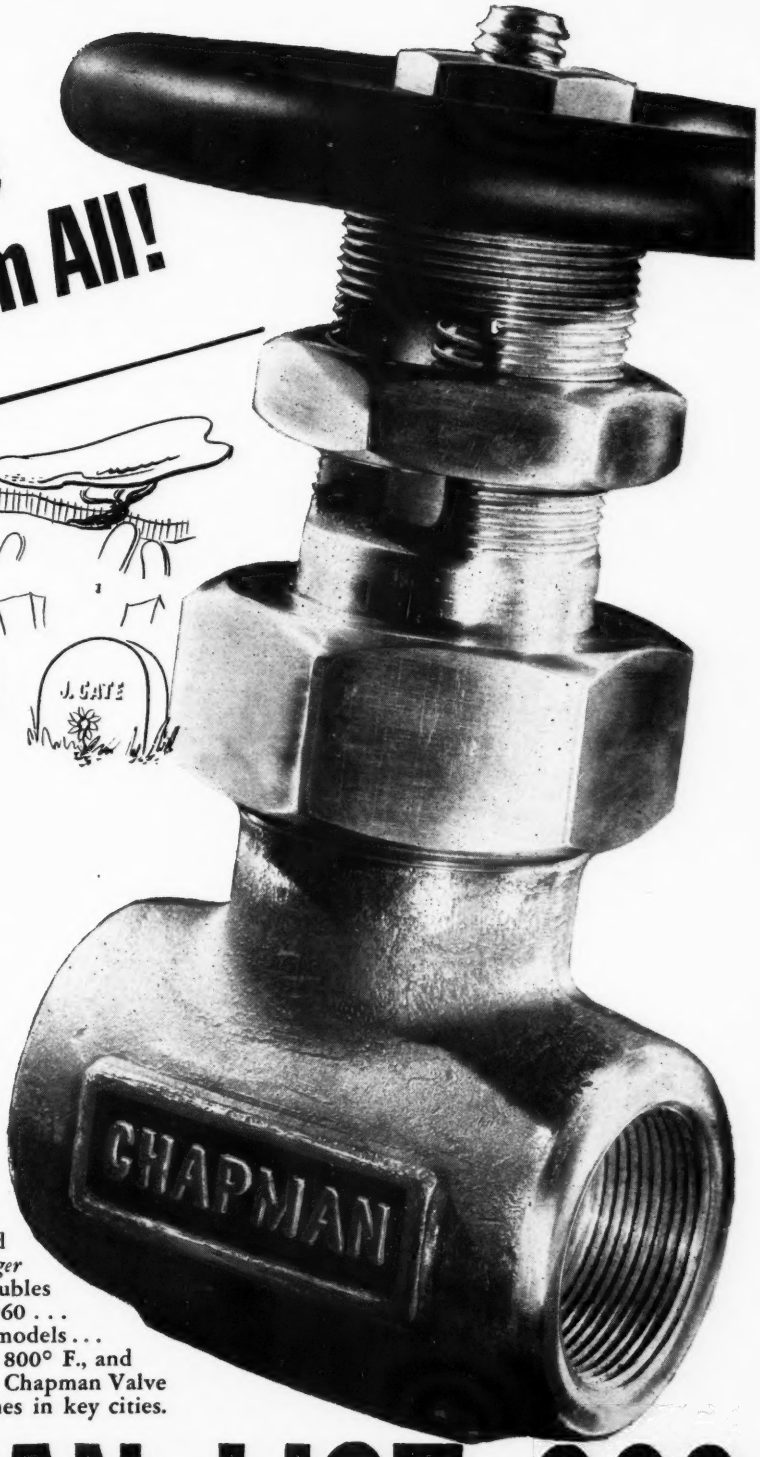
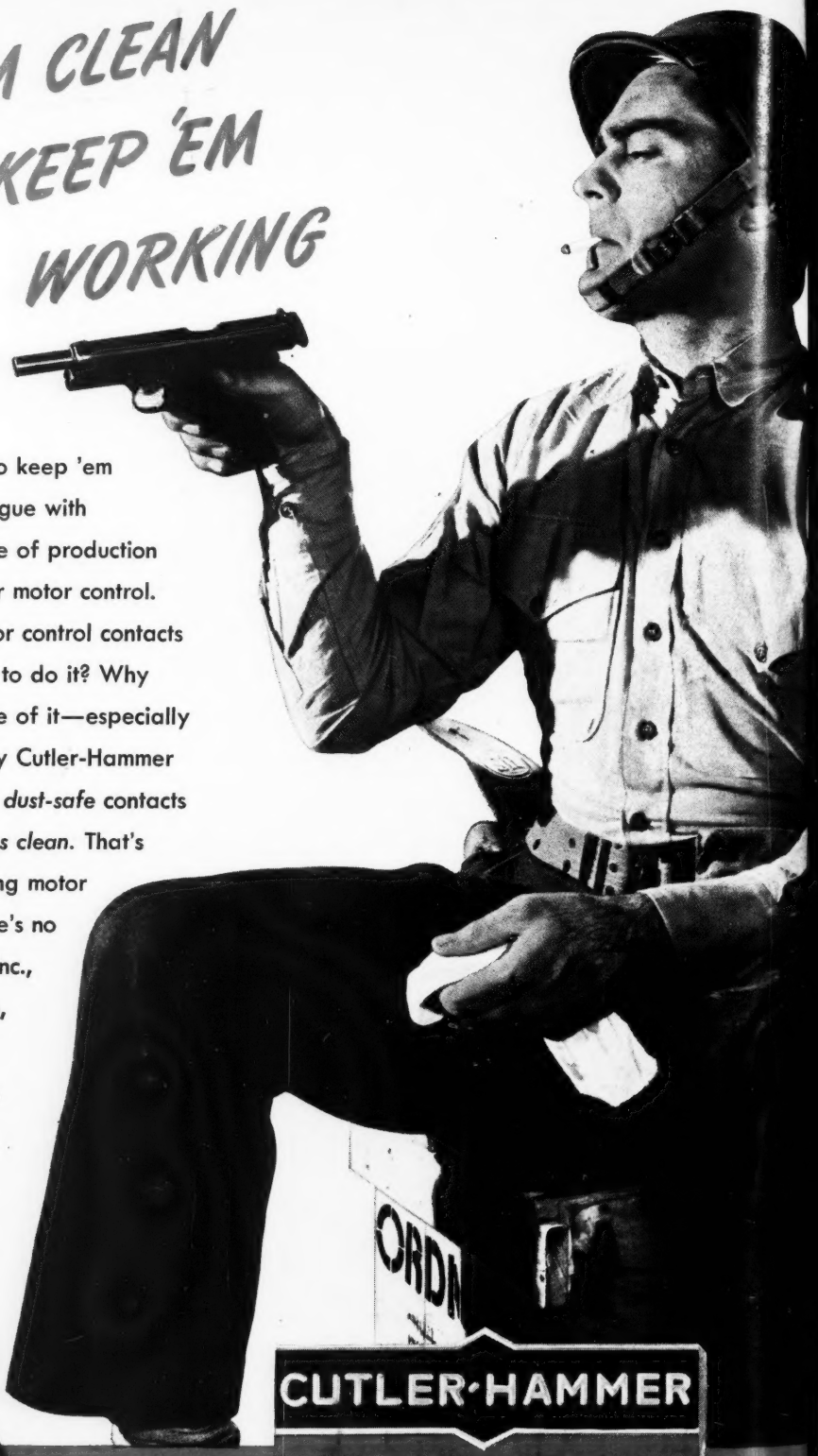


Designed and built to outlive any similar type of small valve, Chapman's forged steel List 960 becomes the "oldest resident" wherever it's installed, on lines from ¼" to 2". And for especially severe duties, this valve may be had with superhardened seats and plugs which impart *even longer life.* So bury all your small-valve troubles for the duration. Standardize on List 960 . . . made in both outside and inside screw models . . . okay for all pressures up to 750 lb. at 800° F., and cold working pressures to 1500 lb. The Chapman Valve Mfg. Co., Indian Orchard, Mass. Branches in key cities.

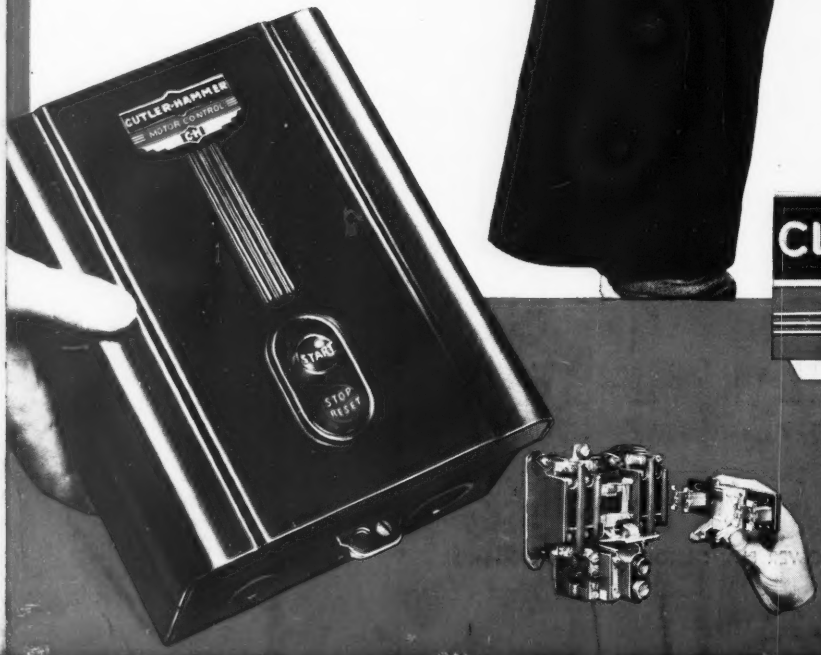
CHAPMAN LIST 960

The Small Steel Gate Valve that's made extra-tough for Extra Life

KEEP 'EM CLEAN TO KEEP 'EM WORKING



You don't have to argue with a man up at the front that it's just good sense to keep guns clean to keep 'em working. Nor do you have to argue with experienced men on the front line of production that the same thing holds true for motor control. Of course you *have to* keep motor control contacts clean . . . but *how* are you going to do it? Why make an *extra* maintenance chore of it—especially when men are so scarce? Specify Cutler-Hammer Motor Control with the VERTICAL *dust-safe* contacts that *shed* dirt and *keep themselves clean.* That's the direct way of insuring unfailing motor control performance . . . and there's no extra cost. CUTLER-HAMMER, Inc., 1392 St. Paul Avenue, Milwaukee, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ont.



CUTLER-HAMMER
MOTOR CONTROL
C-H

Cutler-Hammer Vertical Contacts

OUT IN THE OPEN—NOTHING TO HIDE—You can see the clean contacts in Cutler-Hammer Motor Control as soon as you open the case. They're out in the open where they can work cooler and last longer.

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